THIRTEENTH ANNUAL REPORT

OF

THE RESEARCH DEPARTMENT

OF THE

COFFEE BOARD

1959-60

N.C.P.
C.R.A.M.C.
M.M.

COMMONWEALTH MYCOLOGICAL INSTITUTE
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THIRTEENTH ANNUAL REPORT

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(1st August 1959 to 31st July 1960)

Obtainable From

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COFFEE BOARD

RESEARCH DEPARTMENT

PART V

SECTION ONE

ADMINISTRATION

The report covers the period from 1st August 1959 to the 31st July 1960.

2. Dr. B. T. Narayanan, who, as the Director of Research had been directing the activities of the Board's Research Department for over six years during a period which coincided with the industry's phenomenal progress, laid down office on the 10th August 1959 and entered on terminal leave. Dr. Narayanan brought to bear on the problems of research, the fruit of his mature experience which he had gained in the service of the Government of Mysore in various capacities. While his accomplishment in the field of research was naturally notable his flair for organising the Liaison (Extension) services which have played a constructive role in carrying the message of the research worker home to the planter effectively and thus contributed in no small measure for the increased production of coffee, needs particular mention.

3. I took charge of the department from the forenoon of the 10th August 1959 and continue to be so. The officers named below held charge of the various posts in the department (other than in the extension services) during the year :

(1)	Sri R. L. Narasimhaswamy ...	Botanist.
(2)	,, K. V. George	Mycologist.
(3)	Dr. P. Somasekhar	Entomologist.
(4)	Sri K. C. Ananth	Agronomist (from 18th September 1959).
(5)	,, S. Vishveshwara	Assistant Botanist.
(6)	,, H. T. Ranga Setty ...	Special Officer, P.P.T. Scheme.
(7)	,, B. R. Ananth	Assistant Chemist (from 21st August 1959).
(8)	,, Lazar Soans	Secretary to Director of Research.
(9)	,, C. Ramakrishnan Nambiar...	Superintendent, Coffee Research Sub-Station.

4. The vacancy of the post of Chemist caused by the appointment of Dr. N. G. Chokkanna as Director of Research remains to be filled up.

5. Sri K. C. Ananth, Junior Liaison Officer was appointed to officiate as Agronomist with effect from the forenoon of the 18th September 1959. Sri B. R. Ananth, Research Assistant in Chemistry was appointed to officiate as Assistant Chemist from the forenoon of the 21st August 1959.

6. Sri P. K. Mathew, Assistant Chemist and Sri H. T. Ranga Setty, Junior Liaison Officer, continued to work respectively as Assistant Soil Chemist in charge of the Soil Testing Centre instituted under the Expanded Soil Testing Service Scheme of the Government of

India, and as Special Officer, Proprietary Products Testing Scheme, a special project under the Coffee Board.

Extension Service

7. I was in charge of the direction and supervision of the Liaison (Advisory) Service and held the direct supervisory charge of the Shevaroys Liaison district.

8. The new Liaison district to cover the areas in North Wynaad taluk (Cannanore district, Kerala State) was organized and set up early in June 1960 with its headquarters at Manantoddy. This completes the setting up of the 12 Liaison districts to cover the coffee areas in the South, started as a phased programme towards the beginning of the year 1953.

9. The headquarters of the Koppa Liaison district which was provisionally located at the headquarters of the Research Department was shifted to Koppa with the setting up of a separate office and establishment.

10. The headquarters of the Liaison divisions of North Mysore and South Mysore were shifted to Hassan and Mercara respectively from Saklespur and Somwarpet.

11. Sri M. A. Balasubramaniam, Junior Liaison Officer, on completion of his training in private estate and the Research Stations was assigned the independent charge of the Manantoddy Liaison district.

12. Sri C. K. Ponnappa, Junior Liaison Officer, South Kerala resigned his post with effect from the 6th July 1960.

13. The officers named below held charge of the various Liaison divisions and districts during the year :

HEADQUARTERS DIVISION

(Dr. N. G. Chokkanna, Director of Research

Sri W. Raghavendra Rao, S.L.O. (Devt.).

Shevaroys District	*Koppa District*
(Sri C. K. Vasudevan, J.L.O.)	(Sri H. A. Krishnamurthy, Liaison Assistant).

MADRAS DIVISION

(Sri T. V. Pattabhiraman, S.L.O.)

Nilgiris District	*Pulneys District*	*South Kerala District*
(Sri K. C. Ananth, J.L.O. till 7th September 1959)	(Sri S. J. Mathias, J.L.O.).	(Sri C. K. Ponnappa, J.L.O. till 6th July 1960)
(Sri K. R. Ahobala Rao, J.L.O. from 8th September 1959).		(Sri P. K. Ramachandran, J.L.O. from 7th July 1960).

SOUTH MYSORE DIVISION
(Sri G. I. D'Souza, S.L.O.)

North Coorg District	*South Coorg District*	*Kalpetta District*
(Sri P. K. Ramachandran, J.L.O., till 30th June 1960).	(Sri R. Vijaendraswamy, J.L.O.)	(Sri H. Hanumantha Rao, J.L.O.)

MANANTODDY DISTRICT
(Sri M. A. Balasubramaniam, J.L.O. from 14th June 1960).

NORTH MYSORE DIVISION
(Sri B. K. Chandrappa S.L.O.)

Saklespur District	*Chickmagalur District*	*Mudigere District*
(Sri K. Haridasa Menon, J.L.O.)	(Sri H. S. Puttuswamy, J.L.O.)	(Sri K. T. Bhagat, J.L.O.)

NOTE : J.L.O. = Junior Liaison Officer. S.L.O. = Senior Liaison Officer.

14. Sri L. V. Vaidyanathan, Junior Liaison Officer, who was deputed in the previous year for training in Agricultural Chemical Research in the United Kingdom under the Colombo Plan continued to make good progress.

15. Sri Vaidyanathan had the first phase of the training with Dr. G. E. W. Mallingby in the use of radio active isotope 32p of phosphorous on soil fertility at the Rothamsted Experimental Station under Dr. G. W. Cooke, Head of the Chemistry Department for just over three months. During this period he associated himself in a new experiment to study the residual effect of heavy dressings of phosphate in earlier cropping years to different types of soil in the British Isles and a pot culture experiment employing perennial rye-grass as indicator plant where 32p treatments were imposed to assess the labile phosphate in the soils and also the quantity of soil P taken up by the plants. He also took up a very preliminary investigation into the organic phosphorus contents of various soils whose response curves had been worked out to find out any correlation between organic P and crop responses, if any.

16. Sri Vaidyanathan then worked for about two months at the Long Ashton Research Station under the guidance of Dr. Bould, Head of the Plant Nutrition Division and Dr. J. D. J. Nicholson, where he was engaged in the investigations on the nitric-oxide reductase system in the bacterium *Pseudomonus araginos* and the important techniques employed in enzymology. A method of assay for determining enzyme activity was standardised and attempts were made to purify the enzyme in a supersonic extract of the bacterial mat. A fairly wide coverage was made of the literature on nitrogen metabolism, particularly of higher plants and a preliminary survey of methods of analysis and estimation of nitrogen metabolites in plant tissues was made in order that this may be of help in his later investigations on coffee. He also spent a week with Dr. H. M. Stevens learning his methods of chromotographic separation of trace metals like iron, copper, molybdenum, zinc, tin inclusive of different valency states of iron and molybdenum. He gathered information on the use of radio active isotopes in the laboratories at Long Ashton and also that of the stable isotope N^{15} of nitrogen in tracer studies. He also

held discussions with the various workers, on the subject of plant protection spray applications vis-a-vis equipment and techniques of evaluation.

17. He then reverted to the Rothamsted Experimental Station and worked with Dr. P.W. Arnold on soil potash problems. He took up the general Isotope Course at the Wantage Radiation Laboratory, U.A.A.E.A., from the 16th November to the 12th December 1959.

18. From the 13th December 1959, he has started work on a project entrusted to him by Dr. G. W. Cooke, on the ' Characterisation of ionisable phosphorus in soils '. In this work, he is assigned to work with Dr. O. Talibudeen, Principal Scientific Officer, Rothamsted Experimental Station.

19. The following posts were filled up by promotion/direct recruitment during the year :—

(1) Director of Research ...	1	(4) Research/Liaison Assistants ...	8
(2) Heads of Research Sections ...	1	(5) Ministerial staff ...	8
(3) Assistant Research Officers ...	1	(6) Class IV staff ...	2

20. The sanctioned strength of the department categorywise and number of personnel working against these posts as on the 31st July 1960 are tabulated below :—

Serial No.	Category	Sanctioned strength	Number working
	Class I—		
1	Director of Research	1	1
	Class II—		
2	Heads of Research Sections	5	4
3	Heads of Liaison Divisions	4	4
4	Assistant Research Officers	3*	2
5	Junior Liaison Officers	12	10
6	Farm and Administration	3*	2
7	Special projects	2	1
	Class III.—		
8	Technical	104	74**
9	Ministerial	40*	39
	Class IV.—		
10	Peons, attenders, Gestetner operator, drivers etc.	42	41
		216	178

NOTE.— * Includes 3 posts (one in each) kept in abeyance.

** Does not include 11 undergoing stipendiary training for future absorption as regular staff.

21. The details of the various posts and categories are given in Appendix I. The Board's proposal for the re-organized setup of the Department awaits approval by the Government of India.

22. A special project for the study of the different races of leaf disease (*H. vastatrix*) fungus was sanctioned for a period of one year. The staff required to man this project are being recruited.

23. The two special projects, one for testing of the proprietary products and the other for the study of the triage problem in coffee (cytological, embryological, morphological and co-ordinated observational studies on station selections) continued to function during the year under report.

Leave

24. The several technical, administration and ministerial staff availed earned leave for varying periods during the year. The leave availed by officers during the year are indicated below :—

	Days
Sri R. L. Narasimhaswamy, Botanist	70
,, K. V. George, Mycologist	29
Dr. P. Somasekhar, Entomologist	25
Sri K. C. Ananth, Agronomist	12
,, W. Raghavendra Rao, Senior Liaison Officer ...	25
,, S. Vishveshwara, Asst. Botanist	15
,, Lazar Soans, Secretary to D.R.	81
,, G. I. D'Souza, Senior Liaison Officer	59
,, B. K. Chandrappa, Senior Liaison Officer ...	31
,, S. J. Mathias, Junior Liaison Officer	26
,, R. Vijaendraswamy, Junior Liaison Officer ...	20
,, H. Hanumantha Rao, Junior Liaison Officer ...	50
,, P. K. Ramachandran, Junior Liaison Officer ...	17
,, H. T. Ranga Setty, Special Officer, P.P.T. Scheme	21
,, K. R. Ahobala Rao, Junior Liaison Officer ...	57
,, K. Haridasa Menon, Junior Liaison Officer ...	3
,, K. T. Bhagat, Junior Liaison Officer	17
,, H. S. Puttuswamy, Junior Liaison Officer ...	10
,, C. K. Ponnappa, Junior Liaison Officer	4
,, C. R. K. Nambiar, Superintendent, C.R.S.S. ...	32

Tours

25. I was on tour for 201 days in the year to attend meetings of the Board and its committees and to visit coffee areas in Mysore, Coorg, Wynaad, South Kerala, Nilgiris, Pulneys and Shevaroys. The visits to the coffee areas in the various Liaison districts were mainly for

advisory work, for assessment of the zonal problems by inspections and discussions with the local planters and their associations, inspection of the working of the various demonstration, reorientation and field trials laid out in the planters' fields, selection of sites for setting up Regional Field Stations and for an assay of the pests and diseases position. An assay of the progress against programmes achieved by the recipients of Grants-in-Aid under the Board's Development Plan was made in a cross-section of each of the areas visited by me, and necessary suggestions and modifications to suit the particular seasonal conditions were communicated. An assay of the new problem of the die-back complex facing the industry by visits to a wide cross-section of the affected areas and by discussions with the planting community formed an invariable part of these tours. I visited over 150 big plantations and an equal number of peasant holdings. The sub-station at Chethalli was visited 3 times during the year for inspections and review of the work in progress both in the laboratories and the field. I attended the Indian Standards Convention held at Hyderabad in December 1959. I was in Delhi during December 1959 in connection with the World Agriculture Fair. I attended the Advisory Board Council meetings of the I.C.A.R. in November 1959 and June 1960.

26. The Heads of Research Sections undertook tours in the several coffee tracts in connection with the spot investigations of zonal problems, technical advisory work, inspection of field trials and seed blocks of Station selections, collection of promising material for breeding work, layout of new experiments and to participate in scientific conferences. Number of days each of these officers were on tour during the year is noted below :—

	Days
Sri R. L. Narasimhaswamy, Botanist	94
Sri K. V. George, Mycologist	122
Dr. P. Somasekhar, Entomologist	44
Sri K. C. Ananth	110

27. Sri R. L. Narasimhaswamy, the Botanist and Sri W. Raghavendra Rao, the Senior Liaison Officer (Devt) paid a follow-up visit to the coffee pilot projects established in Assam State and in the Cinchona Plantation areas of the Government of West Bengal in Darjeeling district, for a review of their performance. They spent 18 days inspecting the several project plantings in Assam State and 7 days in the Mungpoo and Munsong plantations in Darjeeling. Sri W. Raghavendra Rao paid a second visit to the Agency areas in Andhra Pradesh for selection of suitable centres for the proposed planting of coffee by the State Government. Sri K. V. George, Mycologist undertook a survey, extending over a period of 37 days, of the coffee tracts in South India to assess the incidence and intensity of the new malady affecting coffee—die-back complex.

28. The Assistant Research Officers, the Research Assistants and the field staff attached to the several technological divisions were deputed to experimental and problem blocks in the different Liaison districts for the execution of the programme work and for collection of data.

Construction of buildings etc.

28(*a*). The construction work at the Research Stations continued to be in charge of the Mysore Public Works Department. The constructions of 3 twin field staff quarters, 2 Senior staff quarters, Labour lines, Workshop and the Farm Stores at the Coffee Research Station

were nearing completion. The constructions of twin type quarters and an implement shed to store the farm implements were completed at the sub-station, Chethalli.

29. The foundation stone of the administrative building at the main station was laid by Sri Tenneti Viswanatham, Chairman, Coffee Board on the 1st April 1960.

30. The following works were taken up directly by the Research Department during the year :—

(i) The construction of a hospital building at the Coffee Research Station has been taken up. The foundation stone for this construction was laid on 1st April 1960 by Sri Tenneti Viswanatham, Chairman, Coffee Board. This construction forms part of the Labour Welfare measures in Mysore State for which allotment of funds are made by the Coffee Board.

(ii) Children's parks have been formed in both the stations with umbrella type platform in the centre and with playgrounds with slide (chute), See-saw, Swing, etc. Fencing, forming flower beds, planting of flower plants and avenue bushes have been carried out. Sri Tenneti Viswanatham, Chairman, Coffee Board, has presented a Radio set for use in the Children's Park at the main station.

(iii) Two bath-rooms with lavatories were added to the Bachelors quarters. One thatched building was renovated during the year with tiled roof, extension of kitchen, provision of a front verandah and a bath-room with lavatory. Twelve lavatories for Class IV quarters were constructed. The southern verandah in the present laboratories was enclosed to provide additional space for the entomological laboratories. A lavatory unit with urinals was constructed near the laboratory building.

(iv) Annual repairs to residential quarters, office and laboratories and the Rest Houses inclusive of sanitary works were carried out in time.

Water Supply

31. A well (18′ × 20′) was sunk in the R valley of the Coffee Research Station and riveted with stone. The well is expected to supply about 6,000 gallons of water per day. Two bore-wells were drilled at the Coffee Research Station—one near the pulper tank and the other in the L valley. These are expected to supply about 3,400 gallons of water per hour. The maintenance of water filters, tanks, wells and the distribution system was attended to.

Library

32. The Department continued to be a member of the Indian Association for Special Libraries and Information Centre, Calcutta. During the year, 4 journals were newly subscribed for the Station Library, bringing the total number of journals being obtained to 88. In addition to this, 30 journals continued to be received on exchange basis. Subscriptions were entered for the supply of *Indian Coffee*, *Indian Farming* and *Indian Horticulture* to the divisional and district Liaison officers, and for the supply of *World crops*, *Planters' Chronicle* and *Tea and Coffee Trade Journal* to the three Divisional Liaison Officers.

33. Two hundred and fifty-two books were added to the library during the year of which 22 books were received as gifts. This brings the total number of books in the library to 1609. Ninety-seven books were issued for equipping the libraries of the Liaison Officers.

34. One hundred and eighty volumes of journals were got bound, bringing the total to 886.

35. At the Coffee Research Sub-station, Chethalli, 11 books were added to the library thus bringing the total in the library to 232.

36. Sri M. K. Visweswara, Fd. Assistant (Junior) attached to the Station Library was deputed to visit the libraries of the U.S.I.S., Indian Institute of Science and the C.F.T.R.I. The training he received has been of great value in the working of the Station Library. The Research Department is highly grateful to the authorities of these institutions in affording all the facilities and for the training given to one of its staff.

Meetings

37. I attended 2 meetings of the Board, 2 of the Research Committee, 5 of the Executive Committee, one meeting of the Development Committee and 2 of the Quality Committee. I also attended 3 meetings of the Working Group of the III Five-Year Plan, 2 meetings of the I.C.A.R. Advisory Board and the U.P.A.S.I. conference and exhibitions. The meeting of the M.S.P.A. was attended. A conference of the officers of the Technical and Extension Wing of the Research Department was held at the headquarters station during April 1960. The Board's Development Officer, the Statistical Officer and Dr. Gilbert R. Muhr, Soil Testing Adviser to Government of India, attended the conference. The conference discussed and reviewed the progress of work against programmes in the Research, Extension and administrative wings and also the budgetary requirements of each section or division. A full discussion on the die-back complex was held during the officers' conference. A uniform procedure in the matter of crop estimation studies, the spot inspections of loan aided estates and collection and despatch of soil, plant, etc., samples was formulated.

38. Informal discussions with the heads of Research and Liaison divisions were held at frequent intervals to assess the progress of various studies under investigation.

Exhibitions and Conference

39. The department participated in the exhibitions held at Delhi in connection with the World Agricultural Fair. The department's liaison wing took part in the exhibitions arranged by the local community as part of the Cattle Shows at Hassan, Mudigere, Megunda and Koppa. The representatives of the Research Department participated in the Indian Standards Convention organised by the Indian Standards Institute at Hyderabad in December 1959.

Correspondence

40. There has been an appreciable increase in the advisory correspondence between the department and the planting community. The correspondence handled at the two Research Stations and the Liaison Offices amply illustrates the considerable interest evinced by planters and others interested in the industry in the improved scientific methods of coffee cultivation advocated by the department.

Budget

41. The expenditure for the financial year 1959–60, in spite of the observance of strict economy in the various sections of the department resulted in a sum of Rs. 1,85,653 under capital charges and Rs. 7,26,057 under recurring charges. In addition to this, an expenditure of Rs. 763 under capital and Rs. 1,70,392 under recurring heads was incurred under the Development Plan during the fiscal year.

42. The budget provision for the financial year 1960–61 anticipates a programme of expenditure of Rs. 3,00,000 under capital works including equipment and Rs. 6,90,500 under recurring charges inclusive of the maintenance of estates at the two Research Stations and the Regional Field Stations. In addition to the above, a sum of Rs. 7,000 under capital charges and Rs. 2,38,600 under recurring charges have been provided for working the Schemes V and VI of the Development Plan during the budget year.

43. The expansion of the Research and Liaison services, initiation of new projects for specialised studies, provision for construction of administrative office building and residential quarters, acquisition of land for the Regional Field Stations, provision of essential equipments for the laboratories etc. account for the increase in budget provision for the year 1960–61.

44. The revenue receipts for the year 1960–61 is expected to reach a figure of Rs. 2,32,000 as against the actual receipt of Rs. 1,93,114 during 1959–60 under research and extension service. The receipts under the development plan are forecast at Rs. 59,000 for the 1960–61 financial year against an actual receipt of Rs. 37,568 during 1959–60.

Audit

45. The audit of accounts of the Coffee Research Sub-station, Chethalli and of Coffee Research Station, Balehonnur for the year 1958–59 were conducted by the Government audit party during September 1959 and January–February 1960 respectively. The Board's accounts officer also checked the accounts of the two stations during September and November 1959.

Visitors

46. The Research Stations at Balehonnur and Chethalli and the Regional Field Stations at Saklespur, Gonicoppal, Kalpetta and Pulneys received many planters and others interested in the planting industry. It was encouraging to note that the trend noticed in the past, of groups of small planters visiting the stations either with the Liaison Officers of their area or of their own accord continued in an increasing tempo. Groups of progressive farmers of Pavagada, Kankanapura and Malur, 96 students (the II year) of the Hebbal Agricultural College and students from the High Schools at Nuggehalli and Kumte visited the Coffee Research Station during the year.

47. The stations were privileged to receive the following distinguished visitors :—

Coffee Research Station :

(1) Dr. Gilbert Muhr, Soil Testing Adviser to the Government of India.

(2) Dr. B. C. Guha, Dr. Sharma and Sri C. P. Natarajan of the C.F.T.R.I., Mysore.

(3) Sri Tenneti Viswanatham, Chairman, Coffee Board.

(4) Dr. B. T. Narayanan and Mr. T. H. Zaliki of Messrs. Rallis India Ltd., Bombay.

(5) Sri Shanmugam, Collector of Central Excise, Bangalore.

(6) Two Russian delegates attached to the Trade Delegation with the Deputy Director of Agriculture, Government of Mysore.

(7) Messrs. Begashao Abebe and Teshab Abebe, Ethiopian Scholars.

Coffee Research Sub-station :

8. Sri S. K. Roy, I.F.S., Consul-General of India (Designate) New York.

9. Sri Jayant M. Patel, Loliondo Coffee Estate, East Africa.

(10) Sri Tenneti Viswanatham, Chairman, Coffee Board.

Field Regional Station, Pulneys :

(11) Sri M. Bhakthavatsalam, Hon'ble Minister for Home, Forests and Agriculture, Government of Madras.

48. The Research Department is indebted to Sri M. Bhakthavatsalam, Hon'ble Minister, Government of Madras for visiting the Regional Field Station in the Lower Pulneys and for laying the foundation stone of the station.

Training in coffee culture

49. The scheme for training of nominees from the planting industry and from State Governments launching upon a project of coffee planting was continued.

50. The department imparted training in the various aspects of office culture inclusive of processing at the estate level to the following candidates during the year :—

(1) Sri K. G. Choudhari,	Nominee from the Government of Bombay.	
(2) Sri T. Rajamannar,	,, ,,	Andhra Pradesh.
(3) Sri H. D. Rothuama,	,, ,,	Assam.
(4) Sri R. Vaidyanathan,	Nominees from the Andaman Administration undergoing training.	
(5) Sri P. O. Alexander,		
(6) Sri M. J. Abraham,		
(7) Sri V. K. P. Nair,		
(8) Sri G. N. Rao,	Nominees from planting industry.	
(9) Sri M. C. Ponnappa.		

51. In addition, field staff recruited during the year were given a preliminary training in the Farm Section and in the liaison districts for periods ranging from one month to three months before they were actually assigned to their functions.

52. Two training classes, one at the main station and another at the sub-station were conducted to demonstrate the Kenyan method of crop estimation to selected Field Assistants from the different liaison districts.

Exchange of seed material

53. Seven types of seeds of *Coffea arabica* and *Coffea horsefieldiana* were obtained during the year by the courtesy of the Director, Institute Agronomico Do Estado De Sao Paulo,

Campinas, Brazil and the Directeur, Institute of National paur L'Etude Agronomique Du Congo Belge. Seeds of shade trees—*Alnus nepalensis* and three species of Albizzia were obtained through the courtesy of the Division Soil Conservation Officer, Mizo district, Assam and the General Manager, Alternate and subsidiary crops, Mungpoo, West Bengal.

54. The following articles were contributed by officers of the department during the period under report :—

(*a*) *Scientific articles :*

(1) Ranga Setty, H. T., Swaminathan, B. and Parthasarathy, S.: Insecticides on Root Mealy Bug, *Indian Coffee*, 23 (8) : 356-58 (1959).

(2) George, K. V.: Stem Wasting ' Kondlie ' disease of coffee, *Indian Coffee*, 23 (3) : 495–96 and 502 (1959) and F.A.O. Pl. Prot. Bull. November, 1959.

(3) Ananth, K. C. and Pattabhiraman, T. V.: Running blossoms in arabica coffee in Nilgiris, *Indian Coffee*, 23 (11) : 497–502 (1959).

(4) Gopalakrishnan, R. and Ananth, K. C.: Transpirational studies on coffee ' (preliminary) ', *Indian Coffee*, (24 (1) : 20–28 (1960).

(5) Research Dept. : Die-back disease in Saklespur and North Coorg areas, *Indian Coffee*, 24 (1) : 29 and 44 (1960).

(6) Ramachandran, P. K. and Ananth, K. C.: A record of Serica sp. (Col. Scarabacidae) on arabica coffee in the Pulneys, *Indian Coffee* (24 (2) : 76, 78 (1960).

(7) Vishveshwara, S. and Nagaraj, T. R.: Nuclear stuatus in Basidiospores of *Hemileia vastatrix* B. and Br., *Indian Coffee*, 24 (3) : 118-19 and 124 (1960).

(8) Nagaraj, T. R. and George, K. V.: A disease of coffee hitherto undescribed from India, *Indian Coffee*, 24 (3) : 120–22 (1960).

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(*b*) *Popular articles :*

(1) Research Dept. : Coffee cultivation in India, Chapters 8 and 9, *Indian Coffee* 23 (8 and 9) : 363–73, 452–59 (1959).

(2) ANANTH, K. C., AND CHOKKANNA, N. G.: Maximisation of coffee production, *Indian Coffee* (24)(2) : 73–75 (1960).

(3) NARASIMHASWAMY, R. L.: Arabica Selection S. 795—Its origin and performance—a study, *Indian Coffee*, 24 (5) : 197–204 (1960).

(4) Research Dept. : Increased incidence of Green Bug on coffee, *Indian Coffee*, 24 (7) : 307 (1960).

54. Abstracts of literature, practical hints to planters inclusive of timely plant protection warning notes for each month, answers to questions received from planters on the different aspects of coffee culture—agronomical, manurial, plant protection and processing—continued to be published in the Board's monthly Bulletin *Indian Coffee* as a regular feature.

55. A brief note on the achievements of the Research Department on past experimental work was prepared and furnished to the Coffee Study Group—Estimates Committee.

As provided in rule 18 (1) of the Coffee Rules 1955 the Board at its meeting on 4th June 1960 appointed a Research Committee for the period from 1st August 1960 to 31st July 1961 with the following members :—

(1) Sri M. Mallaraj Urs, Director of Agriculture Mysore State (*ex officio* Chairman).

(2) ,, A. Venkatesan, Director of Agriculture Madras State (*ex officio* member),

(3) ,, U. K. Lakshmana Gowda, Planter,

(4) ,, P. G. Gurjer, Planter.

(5) ,, A. Achuthan Nair, Planter.

(6) ,, R. Radcliffe, Planter.

(7) ,, M. S. P. Rajes, Planter.

(8) ,, K. M. Varghese Mapillai, Planter.

(9) ,, A. Ramanna (with effect from 24th September 1960) Member Representing Labour.

(10) ,, P. M. Mathew, Director of Agriculture Kerala State (*ex officio* member).

ACKNOWLEDGMENTS

56. I am deeply grateful to the Director, Central Food Technological Research Institute, Mysore, for so generously assisting us in the maintenance and repairs of many of our precision instruments and for the courtesy of helping in analysing various samples.

57. The department is indebted to the many planters who have co-operated with us and assisted us in the conduct of various field trials in their estates. To the various formulators and distributors of proprietary products, I am thankful for help and co-operation extended by supplying materials for the conduct of several experiments.

58. To Dr. A. L. Taylor, Leader, Nematology Investigations and to Dr. R. I. Sailer, Acting Chief, Insect Identification and Parasite Introduction Research Branch, U.S.D.A., Beltsville, Maryland, U.S.A. and to Dr. A. Whitehead, Nematologist, East African Agriculture and Forestry Research Organization, Kenya, I extend my sincerest thanks for the identification of and related information on pests.

59. The Department and I are deeply grateful to the Research Institutes at Florida (U.S.A.), Campinas (Brazil), Lyamungo (Tanganyika), Ruiro (Kenya), Bvumbwe (Nyasaland), Rubona (Belgian Congo), Bealanana (Madagascar), Philippines, Peredinya (Ceylon), Bogor (Indonesia) and Oeiras (Portugal) for furnishing valuable information on the performance of our arabica Station Selections under observation in their trial plots.

60. To the various Research workers and Institutes in India and abroad, my colleagues and I are deeply grateful for the exchange of valuable information (inclusive of published and unpublished literature) on the various aspects of coffee culture and in particular for the ready information furnished to us in our approach to the new problem of die-back complex noticed in South Indian coffee.

61. I also convey my thanks to the various bodies of scientific journals for publishing papers contributed by personnel of this department.

62. Special mention with gratitude is made of the excellent arrangements made by the Pulney planters in connection with the foundation stone laying ceremony of the Regional Field Station in the Lower Pulneys. The success of the function was mainly due to their active co-operation and assistance.

63. The department and I owe a debt of gratitude to all members of the Board and in particular to the Chairman, Coffee Board and Chairman and members of the Research Committee for their kind indulgence, valuable suggestions and timely guidance in our work.

64. To all sectors of the industry, the Planters Associations, the wide circle of planter friends in the various coffee districts, sister technical institutions and the several State Departments of Agricultures, my colleagues and I express our personal gratitude for the courtesy and consideration extended so generously in our contacts with them. To the sister departments of the Board, I am grateful for ready assistance and a willing and ready exchange of information.

65. Brief reviews of work done in the estate and in the different research and extension divisions together with the detailed sectional reports are presented in the following pages.

N. G. CHOKKANNA,
Director of Research.

COFFEE BOARD, RESEARCH DEPARTMENT

APPENDIX I

Statement showing the staff of the Research Department as on 31st July 1960

Serial No.	Designation	Distribution of staff				Total
		H.Q. Station C.R.S.	Sub-station Chethalli	Extension service	Development Plan	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Class I—					
1	Director of Research ...	1	...	...	...	1
	Class II—					
2	Chemist	1 (vacant)	...	...	...	1
3	Botanist	1	...	...	...	1
4	Entomologist	1	...	...	...	1
5	Mycologist	1	...	...	...	1
6	Agronomist	1	...	...	...	1
7	Senior Liaison Officers ...	...	...	3	1	4
8	Superintendent	1 (kept in abeyance)	1	...	...	2
9	Asst. Chemist	1	...	...	...	1
10	Asst. Botanist	1	...	...	...	1
11	Asst. Mycologist	1 (kept in abeyance)	...	...	...	1
12	Junior Liaison Officers ...	...	...	12 (2 vacant)	...	12
13	Secretary to Director of Research	1	...	...	...	1
	Class III—					
14	Head Clerks	3 (1 kept in abeyance)	1	...	...	4
15	Senior Clerks	4	1	...	...	5
16	Junior Clerks	6	2	7	11	26
17	Stenographer	1	...	...	...	1
18	Camp Clerk	1	...	...	...	1

Serial No.	Designation	Distribution of staff				Total
		H.Q. Station C.R.S.	Sub-station Chethalli	Extension service	Development Plan	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
19	Typists	1	1	...	...	2
20	Store Keeper	1	...	...	...	1
21	Research Assistants ...	7	2	...	4	13
22	Liaison Assistants ...	...	...	...	16 (11 vacant)	16
23	Stores Assistant (up to 28th February 1961).	1 (vacant)	...	...	...	1
24	Statistical Assistant ...	...	...	...	1 (vacant)	1
25	Farm Assistant	1	...	...	...	1
26	Junior Scientific Assistant ...	1	...	...	...	1
27	Field Assistants (Junior) ...	11	5	34 (1 vacant)	14 (vacant)	64
28	Foreman Mechanic ...	1	...	...	...	1
29	Fitter	1	...	...	...	1
30	Compounder	1	...	...	...	1
	Class IV—					
31	Drivers	2	1	3	1	7
32	T.B. Attenders	2	1	...	...	3
33	Mechanical Attenders ...	1	1	...	...	2
34	Laboratory Attenders ...	6	1	...	...	7
35	Peons (including Gestetner operator).	6 (1 vacant)	1	15	1	23
	Scheme for testing proprietary products (temporary for three years)					
36	Class II Special Officer ...	1	...	...	...	1
37	Class III Assistants	3 (1 vacant)	...	...	...	3
	Project for Leaf Disease Fungus (Temporary for one year)					
38	Assistant Botanist	1 (vacant)	...	...	...	1
39	Junior Assistant	1 (vacant)	...	...	...	1
	Total	75	18	74	49	216

SECTION TWO

REPORT ON THE WORKING OF THE ESTATE AT THE COFFEE RESEARCH STATION BALEHONNUR, AND COFFEE RESEARCH SUB-STATION, CHETHALLI

There were no changes in the staff of the Farm Sections and Shriyuts T. H. Thimme Gowda and C. Ramakrishnan Nambiar continued as Farm Assistant and Superintendent at the Coffee Research Station, Balehonnur and Coffee Research Sub-station, Chethalli, respectively. Sri B. Swaminathan, Plant Protection Assistant was in charge of the current duties of the Superintendent when the latter was on earned leave during August 1959 and May–June 1960 totalling 33 days in all. The other technical and ministerial staff attached to these sections were on leave for short periods during the year.

Season and climate

2. The Coffee Research Station, Balehonnur received a total rainfall of 111.92 inches (2842.9 mm.) on 155 rainy days as against 137.33 inches (3487.8 mm.) received on 127 rainy days for the corresponding period in the previous year and against 105.76 inches (2686.3 mm.) and 116.85 inches (2968.0 mm.) being the averages for the past ten and 33 years periods respectively. The rainfall during the year under report was thus 21.41 inches (644.9 mm.) less than the previous year and 4.93 inches (125–21 mm.) below the decennial average.

3. The south-west monsoon of 1959 set in, in the middle of June and continued to be unusually active during the months of July and August, the total precipitation being 90.99 inches (2311.1 mm.) Although the monsoon weakened by the middle of September, the month of September was fairly rainy. After an early start in the first week of October the North-East Monsoon tailed off during the first fortnight of November with a definite break during the second week of October 1959 giving a total of 5.54 inches (140.7 m.m.). After the cessation of the monsoon the weather was bright from 10th November onwards excepting for two rainy days in December 1959. Rainfall did not occur in the months of January and February 1960. This drought period aided in the proper maturation and advancement of the flower buds. The blossom showers for the year 1960 were received in the second week of March (16th March 1960, 0.003 inches, 17th March 1960, 0.27 inches, 18th March 1960, 1.30 inches and 19th March 1960, 0.17 inches). The response to this 1.77 inches of blossom showers on three rainy days was satisfactory as it resulted in a good blossom. The blossom set was good both in arabica and robusta.

Good backing showers occurred in April amounting to 9.61 inches and this helped in the development of berries and in the formation of satisfactory new wood. The monsoon for the year 1960 set in by the second fortnight of May continued somewhat intermittently during the month of June and actively in the month of July. There was an unusual break for about a week in the first fortnight in July, during this year. As a result of this break a spurt in the growth and formation of new flush was noticed. This break in the monsoon and the prevalence of bright sunny weather were congenial for the spread of leaf disease in susceptible arabica. The month of July recorded a rainfall of 41.04 inches (1,042.4 mm.) as against 69.89 inches (1,775.21 mm.) received during the same period of last year.

4. At the Sub-station, Chethalli, a total rainfall of 70.24 inches (1,784.3 mm.) was recorded on 115 rainy days as against, 88.82 inches (2,256.0 mm.) recorded for the corresponding period of the previous year. The first blossom showers of 0.72 inches was received on 23rd March although scanty showers of 0.26 inches and 0.12 inches were received on 1st and 20th March. Good backing showers were received from 3rd to 6th April and helped in good setting.

Incidence of Diseases and Pests

5. At the Coffee Research Station, Balehonnur, the incidence of leaf disease during the year 1959 was comparatively low, due perhaps to the low carry over from the previous season. The continuous showers received during August and September 1959 acted as a check on the spread of the disease. However in view of the low crop yield carried and natural better flushing of the bushes it was necessary to take up spraying towards the close of the monsoon. Weather conditions were ideal for the spread of the leaf disease during the early part of the North-East Monsoon and though the intensity of infection was not very marked, defoliation started by December and continued till the end of January. The intervening dry period and the rather complete defoliation resulted in a small carry over of the disease. In view of the early setting of the monsoon the pre-monsoon spray was advanced by a fortnight and was taken up in the last week of April. There was an unusual break in the rains for a week in the first fortnight of July during this year. This break in the monsoon and the prevalence of bright sunny weather were congenial for the incidence and spread of leaf disease. It is anticipated that towards the close of the monsoon, the build of the disease is likely to be considerable necessitating timely post-monsoon spraying.

6. The incidence of black rot was comparatively low during 1960. Damping off, and collar-rot of seedlings in the germination beds as well as in the bed and basket nurseries were at a minimum. However a sudden outbreak of ' brown-eye spot ' disease in the nursery and young clearings during June 1960 was noticed. So far incidence of ' Kondlie ' has not been observed in the nursery seedlings.

7. Incidence of white stem borer during the year was at the same level as in the previous year, 5.0 an acre. The regular programme of rigid tracing of borer affected plants and swabbing of BHC just prior to the flight periods have been responsible for effectively keeping the pest under check. Shot-hole borer incidence was in general, low till January 1960, while beyond this period, the degree of incidence was thrice that, for the corresponding period of 1958–59. Independent tracing of red borer showed that peak incidence was reached in March 1960 with N.M.S. Block V showing the maximum degree of incidence. The incidence in the whole of estate was 3.0 per acre, same as that of last year. Minor pests like leaf eating caterpillars, leaf miners, etc., did not present any serious problem.

8. At the Coffee Research Sub-Station, Chethalli, the incidence of leaf disease was very mild during the year. Timely spraying helped to a great extent in arresting the spread of the disease and the carry over of healthy leaves throughout the year was appreciable. Regular tracing of borer and timely swabbing of insecticides had kept the incidence very low. The incidence of green bug and other pests on coffee was much below pest level.

Die-back was noticed on a few bushes during early May and the plants had recouped after the receipt of good showers in June.

Area—Replanting and New Clearings

9. The area under coffee in the two Stations are :—

	Planted Area (in acres)		Bearing Area (in acres)	
	Arabica	Robusta	Arabica	Robusta
Balehonnur ...	112.74	31.76	95.74	29.00
Chethalli ...	112.31	10.04	111.01	10.04

10. An area of five acres of jungle was cleared at Coffee Research Station and terraces were formed for planting with S. 795 arabica material under intensive cultivation programme. At the Coffee Research Sub-Station, there were no new clearings or replanting during the year.

Crop

11. The yield of uncured coffee harvested during the year is as follows :

YIELD OF COFFEE IN BUSHELS (Uncured)

	Balehonnur						Chethalli					
	Arabica		Robusta		Tree Coffee		Arabica		Robusta		Tree Coffee	
	BS.	SR.	BS.	SR.	BS.	SR.	BS.	SR.	BS.	SR.	BS.	SR
A. Parchment ...	448	26	71	5	2	13	1,476	16	...	...	...	...
B. Cherry ...	469	20	256	0	35	0	1,503	...	145	...	...	...
C. Gleanings and bits ...	67	0	30	0	...	...	128	...	...	...	...	...
D. Others (lights, bits and pulper cuts) ...	94	6½	6	0	...	...	93	...	...	...	...	...
Total ...	1,079	24½	363	5	37	13	3,200	16	145	...	...	...
Yield of Clean Coffee in tons ...	9.25		3.5		0.21		31.0		1.25			

12. A crop of 9.25 tons of arabica, 3.5 tons of robusta and 0.21 tons of tree coffee aggregating to 12.96 tons was harvested during 1959–60 season as against an estimate of 14.75 tons of arabica, 4 tons of robusta and 0.25 tons of tree coffee respectively at Coffee Research Station, Balehonnur. The crop for 1960–61 is estimated at 20 tons of arabica, 12 tons of robusta and 0.75 tons of tree coffee.

13. At the Coffee Research Sub-Station, Chethalli, a crop of 31 tons of arabica and 1.25 tons of robusta were harvested during the year as against an estimate of 30 tons of arabica

and one ton of robusta on blossom. The blossom estimates for the year 1960–61 are placed at 35 tons including robusta.

Seed Distribution

14. In addition to the seed blocks at both the Stations, the zonal seed plots located in private estates, continued to meet the increasing demand of the major station selections. Seven estates in Mysore zone and one on the Nilgiris continued to work as regional seed plots. Seed coffee was prepared under the strict supervision of the Research Department. The quantity of seed collected from these blocks as well as from the two Research Stations is given below :

Sources	Arabica in lbs.	Robusta in lbs.	Tree Coffee in lbs.
1. Coffee Research Station, Balehonnur	1,349	490	82
2. Coffee Research Sub-Station, Chethalli ...	3,441	...	...
3. Zonal Seed blocks	7,803	...	...
Total ...	12,593	490	82

15. A total quantity of 11,444 lbs. of arabica, 542 lbs. of robusta and tree coffee were distributed to 2,512 planters during the year 1959–60 as against 7,746 lbs. of arabica, 1,128 lbs. of robusta and 32 lbs. of tree coffee seeds distributed to 2,205 planters in the previous year.

Paddy and other Crops

16. In the wet lands paddy was grown in an area of 2.50 acres at Coffee Research Station, Balehonnur and 6.00 acres at Coffee Research Sub-Station, Chethalli. A comparative statement of the yield obtained at these two stations are given below :—

Station	Area in acres	Yield of grain in lbs.		Yield of straw in lbs.	
		1958–59	1959–60	1958–59	1959–60
1. Coffee Research Station :					
(*a*) Monsoon Paddy ...	2.50	5,499	4,566	7,500	5,850
(*b*) Summer Paddy ...	2,50	...	5,148	...	3,900
2. Coffee Research Sub-Station, Chethalli ...	6.00	13,512	12,210	10,400	7,800

17. The prospects of the orange crop based on the blossom and subsequent estimates were not satisfactory. A sum of Rs. 815 was realised in 1959–60 as against Rs. 2,519·86 nP. obtained during the previous year. The prospects for the 1960–61 year is better than previous year and is estimated at Rs. 8,000,

Miscellaneous

18. Both the Stations continued to be members of the United Planters Association of Southern India and the Regional Planters Associations. The Sub-Station was also a member of the Coorg Orange Growers' Co-operative Society.

19. The labour strength at Coffee Research Station which was 162 at the end of last year closed with 125 at the end of the year against a sanctioned strength of 170. The average labour outturn was 73% during the year as against 72% of that of last year. The labour strength of Coffee Research Sub-Station, Chethalli was 98 as against the sanctioned strength of 130. The employer-employee relationship continued to be cordial and happy at both the Stations. As usual the Independence Day and the Republic Day were conducted in a befitting manner at both the Stations. The mazdoors were granted holidays with wages on these days and entertained to sports and refreshments.

20. The Canteen intended for the benefits of the mazdoors continued to cater during this period. The creche for the children at Chethalli continued to be maintained. Milk for babies and midday meals for non-working children were provided. A radio was working at each of the Stations.

N. G. CHOKKANNA,
Director of Research.

APPENDIX M-I

Meteorological Data of the Coffee Research Station, Balehonnur, 1959-60

S. No.	Description		Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July
1	Highest Maximum Temperature	... F	80.5	81.0	85.0	82.1	84.5	85.0	90.0	92.0	92.1	92.5	80.5	84.3
		C	26.9	27.2	29.4	27.8	29.2	29.4	32.2	33.3	33.4	33.6	26.9	29.1
2	Lowest Maximum Temperature	... F	68.5	68.5	75.0	76.0	75.1	80.1	82.9	83.0	82.1	75.0	71.0	69.0
		C	20.3	20.3	23.9	24.4	23.9	26.7	28.3	28.3	27.8	23.9	21.7	20.6
3	Highest Minimum Temperature	... F	67.0	66.7	66.5	68.5	66.4	64.0	66.2	67.4	70.0	71.5	68.4	68.0
		C	19.4	19.3	19.2	20.3	19.1	17.8	19.0	19.7	21.1	21.9	20.2	20.0
4	Lowest Minimum Temperature	... F	64.5	64.0	61.0	57.4	56.0	57.0	56.5	59.4	63.4	61.0	63.8	63.7
		C	18.1	17.8	16.1	14.1	13.3	13.9	13.6	15.2	17.4	16.1	17.7	17.6
5	Average Maximum Temperature	... F	73.0	75.1	79.5	78.4	79.8	82.3	85.8	88.0	86.9	84.5	75.7	74.6
		C	22.8	23.9	26.4	25.8	26.6	27.9	29.9	31.1	30.5	29.2	24.3	23.7
6	Average Minimum Temperature	... F	65.7	65.6	64.1	62.4	60.2	60.1	60.5	63.8	66.5	67.9	66.0	66.0
		C	18.7	18.7	17.8	16.9	15.7	15.6	15.8	17.7	19.2	19.9	18.9	18.9
7	Highest Humidity	...%	97	97	97	97	97	97	94	97	97	97	97	97
8	Lowest Humidity	...%	87	90	84	75	49	63	35	72	83	81	81	88
9	Average Humidity	...%	95	95	94	89	81	82	67	93	93	93	93	95
10	Highest number of hours of bright sunshine		7–18	9–00	10–00	10–00	9–30	9–54	10–30	10–30	11–30	10–30	10–00	9–00
11	Lowest number of hours of bright sunshine		...	...	0–18	0–18	0–18	4–30	3–48	5–00	...	0–06	0–12	...
12	Average number of hours of bright sunshine		2–16	2–05	6–37	7–01	7–37	8–38	9–30	8–54	8–02	6–59	3–13	2–35
13	Number of days on which rainfall was below 10 cents		3	8	2	2	...	...	...	1	1	3	8	2
14	Number of days on which rainfall was between 10–50 cents		9	11	8	2	2	...	...	2	2	7	13	8
15	Number of days on which rainfall was between 50–100 cents		11	8	1	...	...	...	...	...	3	...	4	1
16	Number of days on which rainfall was between 1″ — 2″		3	2	2	...	...	...	...	1	5	...	3	6
17	Number of days on which rainfall was above 2″		3	1	...	...	...	...	...	...	...	1	1	9
18	Total number of rainy days during the month		26	22	11	2	2	...	...	3	10	8	21	24
19	Total rainfall during the month	Inches...	21.10	13.70	5.44	0.78	0.39	...	...	1.77	9.61	3.91	14.19	41.03
		Millimetres ...	535.6	348.1	138.9	19.8	10.0	...	...	45.0	244.1	99.3	360.6	1042.1
20	Highest rainfall during the month	Inches...	2.13	2.80	1.87	0.43	0.27	...	...	1.30	1.95	2.29	3.40	6.20
		Millimetres ...	54.1	71.1	47.5	10.9	6.9	...	...	33.0	49.5	58.2	86.4	157.5

APPENDIX M-II

Rainfall Data of the Coffee Research Station, Balehonnur, 1959–60

(Rainfall recorded in Inches and Millimeters)

Serial No.	Month		1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	Average of 10 years	1959–60
1	August	Inches	25.52	20.11	19.40	28.28	30.70	27.90	15.32	19.96	23.14	23.44	23.38	21.10
		Millimetres	648.2	510.8	492.8	718.3	779.8	708.7	389.1	507.0	587.7	595.3	593.8	535.6
2	September	Inches	14.80	21.12	9.77	3.72	6.07	7.69	13.76	6.26	2.44	6.61	9.22	13.70
		Millimetres	375.9	536.5	248.2	94.5	154.2	195.3	349.5	159.0	61.9	168.0	234.3	348.1
3	October	Inches	7.99	6.43	6.74	13.07	20.22	6.41	8.37	12.46	17.30	5.42	10.44	5.44
		Millimetres	202.9	163.9	171.2	332.0	513.6	162.8	212.6	316.5	439.5	137.5	265.2	138.3
4	November	Inches	1.43	1.27	3.12	...	...	...	0.60	4.13	7.27	1.22	1.90	0.78
		Millimetres	36.3	32.3	79.3	...	...	...	15.2	104.9	184.6	30.9	48.4	19.8
5	December	Inches	...	...	...	1.42	...	0.77	...	...	0.05	...	0.22	0.39
		Millimetres	...	...	...	36.1	...	19.6	...	...	1.3	...	5.7	10.0
6	January	Inches	0.02	...	0.14	...	...	...	...	...	0.04	...	0.02	...
		Millimetres	0.5	...	3.6	...	...	...	...	...	1.0	...	0.5	...
7	February	Inches	0.74	...	1.50	...	...	0.28	0.46	...	...	...	0.30	...
		Millimetres	18.8	...	38.1	...	...	7.1	11.7	...	...	...	7.6	...
8	March	Inches	...	0.53	...	...	2.29	1.80	1.12	0.06	1.18	...	0.70	1.77
		Millimetres	...	13.5	...	...	58.2	45.7	28.5	1.5	29.8	...	17.7	45.0
9	April	Inches	0.79	3.84	6.29	2.40	9.18	3.54	6.19	3.34	8.01	2.46	4.60	9.61
		Millimetres	20.1	97.5	159.8	61.0	233.2	89.7	157.2	84.8	203.8	62.5	117.0	244.1
10	May	Inches	3.77	8.43	2.55	0.49	4.40	19.18	3.33	6.69	5.21	4.96	5.90	3.91
		Millimetres	95.8	214.1	64.8	12.5	111.8	487.2	84.6	169.9	132.3	126.0	149.9	99.3
11	June	Inches	11.57	17.38	13.53	15.36	18.56	20.16	28.30	14.95	20.35	25.57	18.57	14.19
		Millimetres	293.9	441.5	343.7	390.1	471.4	512.1	718.8	379.7	517.1	649.4	471.8	360.6
12	July	Inches	58.25	29.31	27.72	54.99	43.09	9.52	37.61	37.25	50.49	67.65	41.58	41.03
		Millimetres	1479.5	744.5	704.1	1396.1	1094.5	241.8	955.3	946.1	1282.4	1718.2	1056.3	1042.1
	Total	Inches	124.88	108.42	90.76	119.73	134.51	97.25	115.06	105.10	135.48	137.33	116.85	111.92
		Millimetres	3171.9	2753.9	2305.3	3041.1	3416.5	2470.1	2922.5	2669.5	3441.4	3487.8	2968.0	2842.9

APPENDIX M-III

Meteorological Data observed at Coffee Research Sub-Station, Chethalli, during 1959–60

Serial No.	Meteorological Observations	Aug. 1959	Sept. 1959	Oct. 1959	Nov. 1959	Dec. 1959	Jan. 1960	Feb. 1960	Mar. 1960	April 1960	May 1960	June 1960	July 1960
1	Highest Maximum Temperature ...	25.0	25.6	28.9	26.7	25.6	26.7	23.9	28.9	32.2	31.1	28.9	26.7
2	Lowest Maximum Temperature ...	21.7	22.2	23.3	18.9	18.9	20.0	20.0	17.8	27.8	22.2	21.1	20.0
3	Highest Minimum Temperature ...	22.2	20.0	23.2	22.2	21.1	20.5	22.2	22.2	24.4	22.8	22.2	21.1
4	Lowest Minimum Temperature ...	20.0	19.4	18.9	17.8	17.8	18.0	18.9	15.6	17.8	17.8	17.8	16.7
5	Average Maximum Temperature ...	23.5	23.9	25.1	25.3	22.5	20.79	20.9	21.1	29.2	26.2	28.29	...
6	Average Minimum Temperature ...	21.1	19.8	22.7	20.5	19.5	19.7	20.8	19.3	18.6	22.7	18.5	...
7	Number of days on which rainfall was below 10 cents	3	4	2	1	1	...	0	1	2	3	10	2
8	Number of days on which rainfall was between 10 to 50 cents	14	9	4	5	1	1	...	3	9	7	7	7
9	Number of days on which rainfall was between 50 to 100 cents	5	5	1	1	...	...	...	1	3	5	4	6
10	Number of days on which rainfall was between 1 to 2 inches	1	3	1	1	...	...	...	...	...	1	1	6
11	Number of days on which rainfall was above 2 inches	0	0	...	...	...	...	...	...	...	...	...	3
12	Number of rainy days during the month.	20	17	6	7	1	1	...	4	12	13	12	22
13	Highest rainfall during the month ...	25.4 (1.00″)	32.5 (1.28″)	33.5 (1.32″)	50.8 (2.00″)	4.6 (0.18″)	5.1 (0.20″)	... ...	18.2 (0.72″)	21.2 (0.84″)	31.4 (1.24″)	35.4 (1.40″)	121.6 (4.80″)
14	Total rainfall during the month ...	228.9 (9.00″)	249.0 (9.41″)	76.2 (3.00″)	106.3 (4.08″)	5.6 (0.22″)	5.1 (0.20″)	... ...	32.5 (1.28″)	117.9 (4.64″)	157.5 (6.20″)	166.6 (6.56″)	680.5 (26.79″)

APPENDIX M-IV

Rainfall Record of Coffee Research Sub-Station, Chethalli, 1959–60

Sl. No.	Month	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	Average for 10 years	1959–60
1	August-Millimetres ...	219.2	233.7	168.8	269.2	389.9	308.1	147.8	255.0	283.7	316.7	259.2	225.40
2	September-Millimetres ...	149.1	351.8	242.3	57.9	45.0	103.6	144.5	63.0	9.4	77.2	124.0	235.40
3	October-Millimetres ...	224.8	82.5	162.1	209.5	353.3	195.1	273.1	281.9	243.8	95.8	211.2	75.00
4	November-Millimetres ...	2.5	102.9	85.9	...	...	...	19.1	130.8	105.4	65.8	51.1	102.00
5	December-Millimetres ...	...	...	...	53.6	...	35.3	...	...	...	...	8.10	5.50
6	January-Millimetres ...	...	...	...	...	...	...	12.7	...	1.3	...	1.4	5.00
7	February-Millimeters ...	18.0	...	2.3	...	14.7	...	0.8	...	...	...	3.5	...
8	March-Millimetres ...	...	55.1	...	4.6	31.0	11.7	4.6	3.8	15.2	0.5	12.7	32.00
9	April-Millimetres ...	30.0	60.2	111.00	54.4	117.3	142.5	125.0	62.2	63.5	31.0	79.7	116.00
10	May-Millimetres ...	94.2	106.4	78.5	26.2	152.1	296.9	74.4	209.3	221.5	110.2	136.10	155.00
11	June-Millimetres ...	173.5	227.3	202.3	309.1	297.4	331.2	474.2	310.9	261.4	560.3	312.8	164.00
12	July-Millimetres ...	726.4	529.8	301.2	827.8	651.8	133.3	552.5	565.7	719.6	997.2	620.5	669.00
	Total-Centimetres ...	163.8	175.5	135.6	181.8	205.3	155.8	182.9	188.2	192.5	225.5	182.5	178.44

SECTION THREE

EXTENSION SERVICE

1. The Director of Research exercised the overall supervisory charge of direction and co-ordination of Extension Services.

2. Organisation

2.1. A distinct liaison unit for the Koppa-Narasimharajapura area with headquarters at Koppa was created in 1959 with a view to serve more effectively the interests of coffee growers in the above tract. This Liaison district covers an area of roughly 20,000 acres and has special problems of its own. The complement of staff consisting of a Liaison Assistant and Field Assistants is in charge of the work. This district which was originally under the direct charge of the Senior Liaison Officer (Development) has now been placed under his supervisory charge.

2.2. Yet another milestone in the progress was the bifurcation of the original Wynaad (Kalpetta) Liaison unit into North Wynaad and South Wynaad Liaison districts. Each of the two new Liaison districts covers an area of roughly 24,000 acres under its jurisdiction. The present setup will cater to the needs of numerous small and big growers in the Malabar-Wynaad belt better and more effectively.

2.3. The proposition to set up an Extension Service to cater to the needs of the planting community as a separate and distinct wing of the Research Department was conceived early in 1953. Consequently, a phased programme to organise 12 Liaison districts to cover the entire South Indian Coffee tracts, was taken up and is now complete. The following are the several Liaison district units :—

	District	Headquarters	Year when started
1.	Chickmagalur	Chickmagalur	1953–54
2.	Mudigere	Mudigere	1953–54
3.	Saklespur	Saklespur	1953–54
4.	North Coorg	Somwarpet	1953–54
5.	South Wynaad	Kalpetta	1953–54
6.	Shevaroys	Yercaud	1953–54
7.	South Coorg	Gonicoppal	1954–55
8.	Pulneys	Dindigul	1956–57
9.	Nilgiris	Coonoor	1957–58
10.	South Kerala	Kottayam	1958–59
11.	Koppa	Koppa	1959–60
12.	North Wynaad	Manantoddy	1959–60

2.4. The three Liaison Divisions of North Mysore (Hassan) South Mysore (Mercara) and Madras (Coimbatore), each of them having 3 to 4 Liaison districts under its jurisdiction continued to function. An effective supervision of Liaison activities in the districts and a

co-ordinated implementation of the several programmes formed the main flank of activities of the officers who manned these divisions.

3. **Growing of Coffee outside the established coffee belts**

3.1. *Assam State :* Under the auspices of the State Forest and Soil Conservation departments, 23 test trial plots covering a total area of 318 acres of coffee have been laid out in the hill districts of Garo, Mikir, Khasi-Jaintia and Lushai. The planting of coffee was taken up in the first instance in 3 plots in the Garo Hills during 1954, and by 1959, all the hill districts had been covered. The trials have been laid on a wide range of elevations, soil and climatic conditions to decide upon the areas best suited for this crop. A follow-up visit to a cross section of these centres was paid by the Chairman, Coffee Board, the Botanist and the Senior Liaison Officer, Research Department, during October 1959. The overall performance of coffee in the project centres was reviewed and recommendations regarding further extension and the potential areas for large-scale commercial cultivation of coffee, were offered. The Chairman, Coffee Board, met the governmental authorities in Assam State and reviewed the prospects of growing of coffee on a large-scale during the Third Five-Year Plan period. Discussions regarding the arrangements to be made for the marketing of coffee, training of technical personnel were also held. A report of the follow-up visit has been furnished to the Government of Assam.

3.2. *West Bengal :* Coffee cultivation was initiated in this State under the wing of the Cinchona Directorate. Twenty-seven trial plots on an exploratory basis have been established beginning from the year 1957–58. The total extent under these trials is 30.93 acres in the Munsong and Mungpoo Cinchona Plantations in Darjeeling district. The initial visit to these centres was paid by Sri K. Srinivasan and Dr. B. T. Narayanan, Chairman and Director of Research respectively then, during October 1958. A follow-up visit was paid to a cross-section of these project centres during October-November 1959 by the Botanist and the Senior Liaison Officer (Development). The vegetative growth in the young clearings was found to be encouraging. The yield performance, the quality of the produce and the economic aspect are still to be judged before any large-scale expansion could be contemplated. A report on the review and recommendations has been forwarded to the concerned governmental authorities.

3.3. *Andhra State :* The Government of Andhra, after a perusal of the Survey Report furnished to them by the Board's Research Department, regarding the suitability of the Agency areas in the Visakhapatnam and East Godavari districts, have taken steps to launch a scheme to establish coffee in four major trial centres. A reconnoitre survey of the tract was again undertaken by the Senior Liaison Officer of this Department and suitable sites for locating the above centres were suggested.

3.4. *Orissa State :* The Survey Report furnished to the Government of Orissa regarding the suitability of the Agency areas in that State for coffee cultivation is still under their consideration. Meanwhile, supplies of small quantities of seed coffee have been arranged to the Soil Conservation Department at Machkund.

3.5. *Andaman and Nicobar Islands :* A survey was conducted to judge the suitability for coffee cultivation in these islands by Dr. N. G. Chokkanna and Sri S. Sundaram in November-December 1958. An area of 15,000 acres was reported to be suited for coffee,

It was recommended that, to begin with, small test trial plots are to be laid to judge the performance of the crop. Seed coffee required for planting such trial centres have been made available during 1959–60.

3.6. *Other areas :* Enquiries from several governmental and other agencies from N.E. Frontier area, Himachal Pradesh, Bhutan, Tripura, Bombay and Madhya Pradesh States on technical matters regarding the cultivation of coffee have been answered. The requirements of the crop in respect of climatic and other ecological conditions have been informed. Questionnaires have been directed to elicit the information required to judge the suitability of these tracts for coffee cultivation.

3.7. The coffee samples picked and processed from the test trial plots of Assam and West Bengal were tested for quality factors. They were seen to possess similar characteristics as of the produce from South Indian Coffee Districts.

3.8. Nominees of State Governments from Assam, West Bengal, Andhra and Bombay were trained in coffee cultivation methods. Candidates of the Andamans Government are still undergoing training.

4. Regional Field Stations

4.1. The first phase of planting of 6 acres with coffee at each of the Regional Field Stations at Saklespur, Gonicoppal and Kalpetta was completed according to schedule during August–September 1959. A further 9 acres have been cleared at each of these stations to lay the varietal, manurial and spacing trials during the ensuing planting season of 1960. The growth of the seedlings in the young clearings is very satisfactory. The post-dry season mortality was below 5 per cent and in many cases the plants have put forth 3 to 5 pairs of primaries. The cost of cultivation for one year's working ranged from Rs. 500 to Rs. 700 per acre.

4.2. The setting up of a similar regional station for the Pulneys area was accomplished. An area of 27.50 acres of jungle land in the Pambukallar Reserve Forest near Kanalkad (Lower Pulneys) was made available to the department for this purpose by the Government of Madras. Necessary preliminaries of jungle clearing, lining and pitting to plant an area of 6 acres during September 1960 are in an advanced stage of progress. Negotiations are still under way to secure a suitable site for locating the Regional Station at Yercaud in the Shevaroys.

4.3. The construction of a well, water reservoir, pump-house and a labour line of four quarters was completed at the Regional Field Stations at Saklespur, Gonicoppal and Kalpetta. At the Regional Station, Pulneys, digging of a well was completed. Building works of an office-cum-store and two units of field staff quarters have been taken up at Kalpetta. Tenders have been called for similar constructions at the other Regional Stations. The Regional Field Station, Kalpetta obtained electric power and attempts to secure ' power supply ' for the Gonicoppal and Saklespur Stations are being actively pursued.

5. General Liaison activities

5.1. Ceaseless propaganda, convincing demonstrations, timely advice and guidance by the advisory services, have aided to make the small planter ' intensive cultivation ' minded. During the year under report 854 demonstrations on scientific cultivation methods were held.

5.2. A rough survey conducted indicates that over 80 per cent of the larger estates of the above 100-acre group bracket, at least 50 per cent of the 50 to 100 acre bracket and 30 per cent of the below 50-acre group have brought into effect intensive cultivation programmes on their holdings. The consumption of fertilizers have increased almost four-fold during the last 5 years. Many more planters are following suit rapidly to implement scientific methods of cultivation to increase crop yields in their holdings.

5.3. The demands for fertilizers and plant protection chemicals by the coffee industry has been on the increase as a result of larger acreages taking up to intensive cultivation practices. The Government of India have been approached for allotment of adequate quantities of these. If they should become readily available in time, a faster rate of progress in stepping up production may result.

5.4. A special feature of the advisory service was the publicising of the calendar of operations to be undertaken during the succeeding month in the Board's monthly journal *Indian Coffee.*

5.5. *Cost of production* : Co-operation was offered to the Marketing Department by the Liaison wing in assessing the cost of production data of coffee, collected by the former, with regard to the technical aspects. Over 200 cases were reviewed during 1959–60 and comments offered.

6. Crop

6.1. The 1959–60 season coffee crop touched yet another new record. According to latest statistics, the total yield is placed at 49,380 tonnes. Even this record crop is expected to be surpassed and left far behind during the ensuing year. A 53,355 tonnes crop is forecast for the 1960–61 season. This reflects in no small measure the high tempo of the department's liaison activity which was geared to bring under the fold of the ' progressive group ' increasing percentage of planters in the below 50-acre bracket.

6.2. An assessment of the influence of the climatic and seasonal factors on crop production was made by the Liaison Officers during their itineration. The information was reviewed periodically.

6.3. The department collaborated with the marketing department in the ' New Scheme of Crop Estimation ' which aims at getting as near an estimate of the coming crop as possible so as to formulate an effective marketing policy.

7. Survey of pests and diseases

7.1. General surveys to assess the pest and disease position formed a routine aspect of work with the liaison services. These were helpful in advocating necessary control measures against the several maladies promptly, and more especially with regard to the timing of the plant protection operations so as to secure maximum benefits.

7.2. On account of the systematic introduction of control measures against White Stem Borer of coffee, the pest is of no significance at the present stage.

7.3. Increased activity of Green Bug on account of too much thinning of shade was generally reported. Control measures to combat the pest were being taken as a regular feature in many estates.

7.4. Shot-hole Borer of robusta was not seen on a severe scale during the year excepting in certain pockets. General phyto-sanitary measures of cutting and burning the affected twigs were able to check the menace considerably.

7.5. Detailed investigations on the 'eel worm' problem have been continued. As a first aid measure, heavy applications of organic manures have been recommended since they have given favourable results in a few estates.

7.6. Spraying with Bordeaux Mixture against *Hemileia vastatrix* (leaf rust of coffee) is almost a *sine quo non* with the culture of leaf disease susceptible varieties of arabica. The severity of incidence during the 1959–60 season was not of much significance in estates where the spraying operations were timely and were undertaken in sufficient number of rounds. The disease was kept under check within reasonable bounds in all estates which have sprayed 3 and 4 rounds.

7.7. Black-rot was noted only in a few patches in the endemic areas. Control measures were at once initiated and the disease brought under control.

7.8. The 'kondli disease' which caused quite a concern during the earlier years was reported only from a few estates during 1959–60 on a gentle scale. Intensive field studies to gauge the extent of damage and the factors responsible for the malady were continued. First aid measures which were observed to give certain amount of control have been widely publicised.

7.9. *Die-back* : Die-back of twigs and branches on account of a complexity of factors have of late been reported from over a number of estates, especially in the south-west monsoon, coffee areas. The intensity of incidence seem to be more severe in places possessing lighter soils. An exhaustive survey was conducted to find out the severity of incidence, the extent of damage and the probable factors constituting the 'malaise'. Intensive and concerted studies both in the laboratory and the field are being carried out.

8. Development Plan

8.1. The schemes relating to collection and distribution of seed coffee, organisation of co-operative and individual pulping units to step up the production of quality coffee and the accelerated programme of demonstration of improved techniques of coffee culture came within the purview of the Research Department. A review of salient features of work for the period under report is presented below.

8.2. *Collection and distribution of seed coffee :* The distribution of seeds of arabica station selections which have been bred for leaf disease (Hemileia) resistance and that of high yielding robusta varieties has been part of the departmental activities ever since 1943. As against a distribution of 8906 lb. of seed coffee to 2205 growers during the year 1958–59, the department issued 11986 lb. of seed to 2512 planters during the 1959–60 season.

8.3. The seed coffee issued during the current season would provide sufficient seedlings to plant an area of approximately 10,000 acres allowing for all losses in germination and mortality in the nursery and post-planting stages.

8.4. The total quantity of seeds of arabica station selections distributed by the department from 1943 is roughly 66,600 lb. Besides, substantial quantities of seed of these varieties have also passed hands between the planters though exact figures of such transfers are not available. The department also undertook raising of seedlings of the leaf disease resistant station selections at the Regional Field Stations for sale to planters. Twenty-five thousand seedlings have been raised and they are due for distribution in August–September 1960.

8.5. Rough surveys have indicated that about 25 to 30 per cent of the present acreage under arabica coffee is occupied by the station selections released by the department. Another feature worthy of note revealed during the survey was the effective halting of the pace of planting robusta. The cosmopolitan character of the vigorous arabica selections, which have been found to thrive well in areas which were once adjudged fit for robusta cultivation only, and their versatile behaviour of performing well under wide ranges of altitudes, rainfall and soil conditions have all helped for the planters' preference of arabica to robusta. A general and a healthy awareness to reduce the existing area under robusta by either grafting to arabica or replanting with arabica station selections in cases of poor and unthrifty stands is gaining ground rapidly. During 1960–61, grafting demonstrations were conducted in 19 estates.

8.6. Concurrently with the large-scale issue of these selections, intensive surveys to study the performance of the new material, cropping behaviour, their response to blossom showers and the quality of the produce in terms of physical grades (triage problem) as well as the cup quality factors have been in operation. These will aid the re-orientation of the breeding programmes to meet the new problems met with.

8.7. Statements of yearwise distribution of seed coffee from 1943, the number of planters to whom issued and the distribution of seed coffee statewise from 1943 to 1960 are furnished in Appendices II, III and IV.

9. Establishment of co-operative and individual pulping units :

9.1. One of the chief items of work undertaken by the advisory section was to step up the production of quality parchment coffee, which will not only have a ready market but will also add substantially to financial returns to the planter. Many holdings of small scale planters were visited during the crop processing season and the scientific techniques involved in producing quality parchment coffee were explained and the methods demonstrated.

9.2. Five out of the six co-operative pulping units started during the earlier years functioned during 1959–60 season. A total of 17,277 bushels of ripe cherry—equivalent to about 80 tons of clean coffee—was pulped at these centres.

9.3. Besides, aids were offered under Scheme V of the Development Plan to individual planters to set up their own pulpers. Suitable pulping equipment and machinery were supplied on hire purchase terms. Seventeen such individual units started functioning during 1959–60 season availing of the assistance, making the total of such units so far established to 18. The quantity of fruits converted into parchment by the above units during the past crop season was 30,373 bushels—representing about 130 tonnes of clean coffee. All this activity has aroused ' parchment consciousness ' among a large section of small scale planters. As a result, it is estimated that nearly 50 pulpers have been established by the planters themselves from out of their own funds during 1959–60 season. The department has received applications from over 75 individual planters requesting for supply of pulping equipment and machinery during the ensuing 1960–61 season on hire purchase terms.

9.4. The figures of pool receipts up to the 15th July 1960 reveal that there has been an appreciable increase in the quantity of parchment coffee received during the current season. An increase of nearly 8,000 tons over the earlier record of 22,000 tons of parchment coffee in 1956–57 has been noted. The following data regarding the total arabica crop and the parchment coffee pooled during the past three seasons may be of interest—

Year	Quantity of parchment coffee pooled In tonnes	Total arabica coffee pooled In tonnes	Percentage of parchment to total pooled
1957–58 ...	21,529	29,598	72.8
1958–59 ...	17,867	25,462	70.2
1959–60* ...	24,986	31,212	80.0

* Receipts up to 15th July 1960

10. Accelerated programme of demonstrations :

10.1. The number of demonstrations and other trails was maintained at 334 to facilitate concentrated working. The general trend of yields in a majority of the plots has been stepped up well over 4 cwt. per acre from the pre-demonstration level of ½ to 1 cwt. per acre. In a few cases, the production has touched even 12 to 13 cwt. level per acre. This has resulted in many small scale planters adopting the recommended practices in their holdings of their own volition contributing to the rise in production standards.

10.2. The total number of estates which received financial aids under the Board's Development Plan was 223. These estates come under the close purview of the extension staff. Suitable calendars of operations were issued to each of these estates and the progress and response of coffee were watched by paying periodical follow-up visits. The distribution of such loan-aided estates in the various liaison districts is given in Appendix V.

10.3. The following data speaks for the magnitude of work turned out by the Liaison Section during the year 1959–60 :—

(1) Number of demonstrations on improved methods of cultivation held	854
(2) Number of group gatherings addressed	253
(3) Number of estates where grafting demonstrations were conducted	23
(4) Number of estates visited for furnishing spot inspection reports in respect of grants-in-aid under the Development Plan	125
(5) Number of follow-up visits paid to loan-aided estates ...	1034
(6) Number of estates (other than loan aided estates) visited ...	4036
(7) Number of exhibitions in which participated	6
(8) Number of advisory notes issued (in person and by correspondence)	7030

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Director of Research.

APPENDIX II

Statement showing the supply of seed coffee of station selections from 1948–49 to 1959–60

Year	Arabica Station Selections lbs.	Kents Arabica lbs.	Robusta S. 274 lbs.	Robusta lbs.	Excelsa Liberica lbs.	Total lbs.	Number of planters to whom seed was distributed
1948–49 ...	150	262	62	759	2	1,235	164
1949–50 ...	253	173	47	506	...	979	168
1950–51 ...	400	366	40	1,046	1	1,853	237
1951–52 ...	695	80	45	1,139	...	1,959	228
1952–53 ...	888	45	35	875	9	1,852	310
1953–54 ...	1,456	20	106	720	31	2,333	500
1954–55 ...	5,421	...	77	800	39	6,337	1,247
1955–56 ...	10,669	...	189	1,164	27	12,049	1,693
1956–57 ...	13,397	...	45	296	26	13,764	2,034
1957–58 ...	13,504	...	34	780	14	14,332	2,529
1958–59 ...	7,746	...	136	992	32	8,906	2,205
1959–60 ...	11,444	...	106	358	78	11,986	2,512
Total ...	66,023	946	922	9,435	259	77,585	...

APPENDIX III

Statement showing the distribution of seed coffee in Liaison Districts during 1956–57 to 1959–60

Name of the Liaison District	Year 1956–57		Year 1957–58		Year 1958–59		Year 1959–60	
	Arabica	Robusta	Arabica	Robusta	Arabica	Robusta and Excelsa	Arabica	Robusta and Excelsa
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1. Chickmagalur ...	1,721	26	1, 043	9	772	3	1,099	8
2. Mudigere ...	3,143	74	3,355	65	1,068	40	1,496	23
Koppa ...	...	...	...	...	821	64	814	15
3. Saklespur ...	1,623	30	1,406	12	879	33	1,150	18
4. North Coorg ...	2,346	3	1,350	12	908	22	1,274	8
5. South Coorg ...	1,650	2	3,120	102	789	145	1,340	85
6. Yercaud ...	428	...	304	2	206	...	333	8
7. Kalpetta ...	1,439	82	722	220	329	330	409	109
8. Coimbatore—Annamalais ...	462	128	1,906	176	328	56	482	13
9. Pulneys ...	...	...	...	...	944	12	1,520	8
10. Nilgiris ...	...	...	...	...	433	...	518	10
11. Kottayam ...	...	...	...	...	198	455	325	234
12. Other areas ...	585	22	298	230	71	...	684	3
Total ...	13,397	367	13,504	828	7,746	1,160	11,444	542

APPENDIX IV

Statement showing the distribution of seeds of improved strains of arabica coffee from the Research Department, Coffee Board according to Zones/States from 1943 to 1960

Serial No.	State/Zone	Distribution of seed coffee in pounds					
		S. 795	S. 288	S. 333	S. 645	Others	Total
	Madras State						
1	Shevaroys ...	1,219	379	33	16	93	1,740
2	Pulneys ...	2,160	1,142	37	10	10	3,359
3	Coimbatore and Nilgiris ...	3,317	595	131	79	85	4,207
	Total ...	6,696	2,116	201	105	188	9,306
	Mysore State						
4	Chickmagalur ...	5,804	1,772	696	89	277	8,638
5	Mudigere ...	7,790	3,968	1,187	27	249	13,221
6	Koppa ...	1,472	155	8	...	...	1,635
7	Saklespur ...	4,187	2,629	534	26	597	7,973
8	North Coorg ...	7,284	1,082	300	34	229	8,929
9	South Coorg ...	8,791	893	53	161	162	10,060
	Total ...	35,328	10,499	2,778	337	1,514	50,456
	Kerala State						
10	Kalpetta ...	3,640	418	115	18	52	4,243
11	Kottayam ...	511	8	4	...	...	523
	Total ...	4,151	426	119	18	52	4,766
12	Andhra State ...	240	73	23	...	...	336
13	Assam State ...	958	352	111	...	1	1,422
14	Bombay State ...	2	7	...	...	...	9
15	West Bengal ...	68	44	12	...	...	124
16	Madhya Pradesh	1	14	8	...	...	23
17	North-East Frontier Province ...	4	4	...	...	...	8
18	Manipur ...	10	12	...	...	3	25
19	Orissa ...	32	13	...	...	...	45
20	Andaman Administration ...	4	4	4	4	...	16
21	Sikkim ...	...	2	...	...	...	2
22	Others ...	15	10	10	...	...	35
	Grand Total. ...	47,509	13,576	3,266	464	1,758	66,573

In addition to the above, 10,467 lb. of seeds of Robusta Selections have also been supplied to growers from the department during the period 1943 to 1960.

NOTE :—One pound of seed coffee of arabica and half a pound of robusta is considered sufficient for raising seedlings to plant one acre.

APPENDIX V

Liaison Districtwise Distribution of estates which have received Grants-in-aid under the Board's Development Plan—as on 31st July 1960

Serial No.	Liaison Dist/Divn.	Number of estates which have received Grants-in-aid	Number of estates visited for spot investigation (1959–60)
1	Chickmagalur	31	10
2	Mudigere	37	13
3	Saklespur	42	21
4	North Coorg	26	13
5	South Coorg	28	19
6	Mercara Division	14	2
7	Manantoddy	1	12
8	Kalpetta	21	23
9	Pulneys	11	3
10	South Kerala	...	2
11	Yercaud (Shevaroys)	7	4
12	Nilgiris	4	3
13	Koppa	1	...
	Total ...	223	125

SECTION FOUR

A. SUMMARY OF RESEARCH

I. AGRONOMY

1. During the year research in Agronomy Division underwent a period of reappraisal with a view to change certain aspects of its programme. The experiments started earlier on the influence of different cultural practices on yield of coffee, robusta manurial trial and mulching young arabica coffee were continued. Crop estimation studies initiated earlier were continued at the two Research Stations and in selected estates in liaison districts.

2. The experiments on soil cultivation practices laid out at the Coffee Research Station, Balehonnur and at the Coffee Research Sub-Station, Chethalli were in progress. The growth studies and soil moisture assay were conducted and it revealed that growth habit of coffee was related to the moisture status of the plots under different treatments. Further, the yield data collected during the year were not statistically significant at Coffee Research Station, Balehonnur. But the results recorded at Coffee Research Sub-station, Chethalli showed significant difference among the treatments. The treatments of light digging in November and renovation pitting were significantly superior to the rest of the treatments including control. However, there was no significant difference between light digging in November and renovation pitting.

3. The soil management experiment, mulching and mulching-cum-manurial trials at Coffee Research Station, Balehonnur and the yield recorded from these experiments did not give any significant response to the treatments.

4. The results obtained from the Robusta Manurial Trial, which was laid out in the year 1951, did not give any significant response from the commencement of the experiment, including the current year. However, the plot receiving 80 lb. nitrogen gave numerically higher yields during the previous two seasons. Contrary to this trend the yield recorded this season showed that 40 lb. of nitrogen application was better than rest of the treatments. The same trend was also noticed in the robusta manurial and pruning experiment laid out in a private estate.

5. The crop estimation studies were continued at the two Research Stations and in the selected estates of different Liaison districts. The results obtained this year showed quite an amount of variation. Perhaps, these variations may be due to the incidence of ' Die-back ' complex at varying degrees which might have brought about heterogeniety in plant yields. The studies will be continued for one more season to standardise the method.

6. The long-term experiment on shade requirement of arabica coffee laid out in 1955–56 at Coffee Research Sub-station, Chethalli was discontinued.

7. Experiments to evaluate transpirational loss from species and varieties of coffee were carried out at Coffee Research Station during November–December, 1959. Summing up the results it was interesting to note that fungal infections increased the transpirational rate while spraying both surfaces of coffee leaves with 0.5% Bordeaux Mixture helped very

much in checking the transpirational loss, ultimately resulting in the water economy of the plant.

8. Weedicide trials started during the year and the results obtained, singled out ' Dowpon ' as an effective grass eradicant. Further trials with this chemical are in progress.

9. As one of the many approaches to study the ' Die-back Complex ' problem, emphasis is being laid to build the plant vigour with satisfactory retention of leaves. Towards this end ' Result Demonstration Blocks—Project Die Back '—5 acres in extent were started during this year in representative estates and observations are in progress.

10. Mechanical and reciprocal grafts transmission of malformations and virus-like symptoms in arabica coffee are being studied by this division.

11. In the studies of germination of seeds, the results obtained showed that shade drying in the preparation of seed coffee was best both for arabica and robusta. While studying the effect of pre-soaking the seeds in cold and hot water on their germination capacity, it was observed that soaking the seed coffee without their parchment cover for 96 hours in cold water gave maximum percentage of germination. The trials with seed coffee treated with different hormones in varying concentrations exhibited a trend of early emergence by a fortnight's time when compared with untreated controls including estate nursery practice.

12. Preliminary observations, on slow sprinkling overhead irrigation of robusta and arabica coffee during February–March period revealed that uniform blossoming was forced out in the case of robusta. On the other hand running blossoms were noticed in the case of old arabica. It was also interesting to note that flush production in the irrigated blocks was earlier than usual and thus fresh incidence of leaf disease was noticed during February, March and April.

II. BOTANY

13. Coffee breeding with reference to leaf disease resistance and high and even bearing qualities was continued. Inter and intra-specific crosses to combine desirable characters from selected parents, collection and establishment of coffee and shade tree plant material from countries outside India and from Indian states to serve as foundation stock, field tests of advanced generations of coffee selections and hybrids, vegetative propagation of promising material and comparative trials of clonal progeny, cytological and allied studies on the triage problem in coffee, and, production of seed coffee from approved selections for supplying to growers formed the principal work of the Botanical division.

14. Twenty-three crosses were effected during the year between selected plants of first generation of S. 795, with low percentage of false polyembryony, as well as first generation of S. 44, with selected plants of K.P. 423—a high yielding Kents arabica selection from Lyamungu, Padang, Phillippinean, Blue-Mountain, possessing good bean characters : Ethiopian collections S. 12 Kaffa, S. 8 Taffarikela and Rume and Barbuk collections showing freedom from leaf disease in the field, with a view to improve the bean characters of station selections and further fortify their resistance to leaf disease.

15. Out of 68 intra-crosses between arabica selections and collections established from 1952 to 1958 that are under study, 9 continued to show freedom from leaf disease in the

field, and 52 showed susceptibility ranging up to 30%. Seven cultures that showed over and above 30% susceptibility were discarded. The yield of the cultures planted from 1952 to 1954 ranged up to 4.2 cwt./acre during the year as against up to 7.5 cwt/acre in the previous year.

16. Among the cultures planted between 1957 and 1960, these are combinations which include cross-breds between (1) Station selections S. 288, S. 333, S. 795, S. 44 and their progeny, and (2) S. 12 Kaffa, Rume and Barbuk, (3) K.P. 423 and (4) Philippinean, Padang and San Ramon. The behaviour of the cultures in the field so far indicates that leaf disease resistance is dominant.

17. A high degree of resistance to the common races of leaf disease that affects Kents and Coorgs arabica is continued to be maintained in the 1st and 2nd generation of S. 795. They also maintain the vigorous growth characteristic of the strain. Over a period of four years, the first generation cultures have averaged yields at 6 cwt./acre. The yield, however, affected it by the yearly programme of bagging for controlled pollination as well as analysis of fruits at various stages of development.

18. Trials to isolate best performers from seedling and clonal progeny of selected arabica (BA series) and robusta (BR series) cultures were continued. The former maintains freedom from leaf disease in the field. The yield of the cultures was low during the year. This was particularly noticed among the robusta cultures some of which did not record any yield. This keeps in level with the low yields in the station estate and in the neighbourhood. B.A. 12, 11, 19, 13, 36, 23, 18, 28 and 16 among arabica and B.R. 6, 12, 10 and 14 among the robusta cultures lead the other cultures in yield.

19. Studies on robusta arabica hybrids, their back-crosses and progeny were continued. They maintain high degree of resistance to leaf disease in the field, and the selected plants among them continue to produce high yields over 11 cwt./acre. The produce, however, contained high percentage of floats ranging up to 23.6% and high percentage of peaberry 12.8 to 85.2%.

20. In the F_1 progeny of the inter-specific hybrids between *C. excelsa*, *C. canephora* and *C. eugenioides* a number of plants occur closely resembling the female parent, suggesting that they may have arisen out of parthenogenetic development. In the remaining plants a wide variation is noticed. These latter also show a high degree of sterility.

21. Exchange of seed material between India and other coffee growing countries were continued. During the year seedlings of Cioccie, Agaro, Dilla and Alghe, Dalecho and Kaffa mentioned as showing resistance to No. 7-8 races of leaf disease out of the ten established by Dr. Branquinho d' Oliveira, were planted in the fields.

22. The coffee gene bank established at the station includes practically all the commercially important varieties among established coffees in the several coffee growing countries of the world, material that is mentioned as resistant to 8 out of 10 races of leaf disease of Dr. Branquinho d' Oliveira, reputed high yielding selections from Coffee Research Institutes, and coffee species of academic interest for coffee breeding. Among the varied collections of material, Ethiopian collections Taffarikela, S. 12 Kaffa, Rume and Sudan collections and *C. salvatrix* show either freedom from leaf disease or a high degree of resistance in the field.

Cioccie, Agaro, Lilla and Alghe, Dalecho and Kaffa planted during 1960 are still too young and are under observation.

23. The eight regional seed plots of S. 795 continued to function together with those at the two stations. Seed coffee was collected from these under departmental supervision and supplied to growers. Sample seeds for trial purposes were supplied to Sarawak, Belgium Yugoslavia and Portugal.

24. Encouraging reports have been received on the performance of station selections supplied to countries outside India from 1952–53. Dr. Branquinho d' Oliveira has established S. 288-23 type reaction as Class G and S. 353–4/5 type reaction as Class H. The resistance indicated is to 7 and 8 out of 10 races established by him.

25. Field resistance to leaf disease of the selections has been reported from Philippines, Madagascar, Tanganyika and Kenya. The vigorous growth, particularly of S. 288 has been remarked by Philippines. First yields up to 4–5 cwt./acre are reported from Tanganyika and much higher yields (19 cwt./acre approximately) from Philippines. The cup quality assessed in Tanganyika is F.A.Q. and above.

26. The standardised technique for conversion of robusta or hybrid stocks without stumping them, by wedge-grafting green tender suckers arising on the main stem at 12 to 15" from ground level, with similar type of scion-wood is being successfully adopted by estates in large-scale grafting. Performance of the earlier grafted field is satisfactorily commented upon. Regional demonstrations in grafting were held in five Liaison zones in Mysore and Kerala States and were attended by groups of big and small estate holders.

27. For the fourth year in succession, single-noded green-leafy-sucker-cuttings treated with Seradix L. 15 have given over 70% rooting, as against control with 45.6% Seradix L. 30 and cow's urine extract at 60%.

28. Experiments laid out to compare the performance of both arabica and robusta trained by the multiple stem as against the common practice of growing coffee on single stems showed over a period of 9 years that practically no differences in yields are noticeable with arabica, whereas due to heavy incidence of Shot-hole borer infection in the multiple stems of robusta, the yield from these plots is 53% less than single stem plants.

29. Falsepolyembryony (production of more than one ovule in the same locule) which results in bits and hollows of triage, occurs in S. 288 and progeny from 20.9 to 42.9%, in S. 795 and progeny from 4.9 to 12.5% and in Kents and Coorgs arabica 3.1%. Truepolyembryony occurs up to 0.24% in all of them. False and true polyembryony vary from season to season e.g., S. 795 (1st gen.) recorded 19.2% ,6.7% and 11.6% during 1958, 1959 and 1960 respectively.

30. Three bean fruits, black beans and brown beans occur up to 1.6 to 1.95% in station selections Kents and Coorgs arabica.

31. Malformed beans of triage may also result from other causes which are not yet clear. This forms the major portion of triage in Kents and Coorgs arabica. It is also not yet clear to what extent age, environmental and nutritional factors influence triage production.

In a very preliminary exploratory trial on Kents arabica there appears to be a trend of high triage with applications of NK as against N, or NP or NPK.

32. In the trial to study the performance of station selections at Sub-station, Chethalli, on an aggregate of 9 years yields, S. 795 leads the others followed in order by S. 645, S. 288 and S. 446.

33. A good collection of shade trees from sources in and outside India is continued to be established as foundation material at Balehonnur Station. When they commence to produce seed, promising species are proposed to be supplied for trial in the several coffee area.

III. CHEMISTRY

34. Experiments on the manurial requirements of coffee, influence of trace elements on the growth and vigour, land management with special reference to soil and moisture conservation were continued.

35. The manurial experiments, to study the essential requirements of major plant foods either singly or in combination has completed 20 years. It is noticed from the yield data that nitrogen in combination with phosphoric acid and potash has given high yields. During the previous years, nitrogen in combination with phosphoric acid had recorded higher yields.

36. Fundamental Manurial Experiments on the application of varying levels and combinations of N, P and K were continued. Trials on varying doses of nitrogen from 40 lb., to 100 lb. to the acre with fixed levels of P and K, trials on different sources of nitrogen and the trials with varying doses of phospheric acid and potash with a constant level of nitrogen were also continued. These trials bring out the relative importance of a balanced fertilizer application.

37. Field trials to find out the optimum economic doses of nitrogen and the role of phosphates and potash in utilization of nitrogen were continued. The results obtained stress the importance of the application of P and K in the proper utilization of nitrogen.

38. Field Manurial Trials to study the application of different levels of nitrogen from 40 to 100 lb., to the acre with fixed levels of phosphates and potash on arabica and robusta were continued in different soil and climatic zones of coffee growing areas. These bring out the importance of split doses of nitrogen with adequate quantities of phosphates and potash. The experiments on arabica were concluded after the harvest of 1959–60.

39. Field trials on the effect of varying levels and combinations of N, P and K, on the growth and yield of robusta coffee were continued.

40. Field trials to study the effect of Chelated metals and trace elements on the yield and vigour of plants were continued. Similar trials started in pots in 1959 were also continued.

41. Observational trials to correct minor element deficiencies of coffee laid out in Neranki estate show that the plants sprayed with tracel and zinc + copper + manganese mixture, respectively, improved distinctly when compared with the other soil and spray applications.

42. Studies on the uptake of plant nutrients in seedling show (1) the total quantity of plant nutrients taken up by the plant decreased with the increase in fertilizer application. (2) Heavier application of fertilizers in the nursery had a depressing effect on the growth of seedlings. (3) Provided the plants are grown in a rich medium of soil, further application of fertilizers may not be of much advantage.

43. Analysis of plants of different age groups and their parts indicate that nitrogen and phosphoric acid are high in young coffee (3 years), whilst the older coffees (15-20 years and 40 years) contained higher quantities of potassium and calcium than is present in young coffee.

IV. ENTOMOLOGY

44. *Survey :* Survey on the intensity of incidence of pests of coffee was continued. Additional number of *eelworm* infected localities, dispersed in Pulneys, Nilgiris, North and South Mysore, were detected. The incidence of *green bug* was reported to be severe at Chickmagalur, Saklespur, Mudigere, Koppa, Shevaroys and Nilgiris during the latter part of the year. *Shot-hole borer* incidence was, in general, low at the Coffee Research Station, Balehonnur, till January 1960, while beyond this period the degree of incidence was thrice that for the corresponding period of 1958–59. At North Kerala, increased incidence was evident from June 1960. *Red borer* infestation did not cause much alarm. At the Station, N.M.S. V showed the highest degree of incidence and the peak in the whole estate was reached around March. The figure of incidence for the season was 3 per acre. Incidence of *white stem borer* was increasingly felt in some parts of North Mysore. Incidence of *hairy caterpillars* was reported in a few estates on the Nilgiris during early 1960.

Applied Research

45. Of the three *white stem borer* control experiments started earlier with BHC. 50 W.P. (applied twice and thrice per year), Dieldrin 50 W.P., Heptachlor 25 W.P. and Gusathion 20 E.C. (applied twice per year), two—Perumbucolly and Godhanda experiments—gave significant results. It was seen that BHC. (@ 1.0% a.c.) applied thrice and Gusathion (@ 0.1% a.c.) applied twice gave consistently superior results as compared to Dieldrin (@ 0.125% a.c.) and BHC. applied twice. Heptachlor (@ 0.1% a.c.) was less effective. Samples of Arabica Coffee obtained from three blocks at the Station receiving various sequences of BHC. swabbing were sent abroad for *quality tests* and the results are awaited. Laboratory trials on the effect of systemic and non-systemic insecticides (@ 0.01% and 0.02% a.c.) on the *green bug* showed that Folidol was consistently effective at various time intervals. Malathion, though comparably effective at low concentration, was surpassed in action by the high concentrations of Basudin, Gusathion, Fosferno and Paramar, especially at 72 and 96 hours after treatment. Field spray experiments with the systemics, Rogor, Meta-iso-Systox and Ekatin, and with other non-systemics, showed that the latter (Paramar, Fosferno, Folidol, Gusathion, Ekatox and Malathion) were superior to the former—except Meta-iso-systox which showed almost comparable effectiveness. Further trials are anticipated. Extended field trials with the aforesaid systemic insecticides and Gusathion on *shot-hole borer* at various levels of concentration were started. Trials with SWING-FOG " on *hairy caterpillars* proved inconclusive. Experiments with the nematicides, Nemagon and EN-18133 ; systemic insecticides, Ekatin and Meta-iso-systox ; and non-systemic insecticides, Gusathion and Malathion ; on *coffee eelworms* were commenced. A field experiment to assess the possibilities of eelworm control through French Marigold was in progress. Data from the experiment at Wooligooly estate

indicated that the treatments, soil amendments and farmyard manure, promoted better plant growth condition ; the latter also aiding in increasing the predacious eelworm population in the soil.

Basic Research

46. Studies on the habits, life history and ecological relationships of the *red borer* were pursued and these on the life history of a species of *leaf skeletonizer* were culminated. The biological relationships of a species of *parasite* attacking red borer larvæ were studied in some detail. Several other parasite species from green bug, red borer, dadap borer and hairy caterpillars were collected and these were got identified through the U.S.D.A. The distribution of eelworms in coffee zones has been determined for 1959–60. Preliminary studies on the physical and biotic factors influencing eelworm population were taken up.

V. MYCOLOGY

47. Incidence of leaf disease caused by *Hemileia vastatrix* continued to be mild till about middle of November 1959. Due to conducive weather conditions, a spurt in the disease activity and consequent spread was noticed during December 1959 to January 1960. Consequent on a large carry over of disease inoculum, receipt of early blossom showers and considerable delay in setting in of south-west monsoon, leaf disease incidence and spread is comparatively more. Black rot, Collar-rot and Brown-eye-spot diseases continued to be well under control. A peculiar type of ' die-back ' was observed during the summer month.

48. Results from spray trials comparing different proprietary formulations with Bordeaux Mixture for controlling leaf disease indicated that a majority of cases, no significant differences were observed. However in cases, where significant differences were observed the present standard 0.5% Bordeaux was found to be superior to one or more proprietary formulations under test.

49. A trial has been started recently to study the effect of alternating applications of eradicant fungicides with protectant Bordeaux sprays in the control of leaf disease.

50. Test with the low volume " Micronette " sprayer showed that, though considerable economy in the volume of spray mixture could be effected through the use of this machinery, due to practical working difficulties and extra time required, the machinery does not appear to be suitable for spraying in covered mature coffee.

51. In order to study the efficacy, utility and economics of increased rounds of spray and their timings in the control of leaf disease of coffee to keep pace with the continued flushing habit, observed in coffee today, induced by liberal artificial fertilising and opening up of overhead shade, a spray trial has been started recently, incorporating different numbers of rounds of spray per year ranging from 2 to 5 and at different periods.

52. Preliminary studies on the cytology of the rust fungus *Hemileia vastatrix* B. & Br., showed the occurrence of binucleate condition in the basidiospores.

53. Berry Blotch disease observed since 1957, has been found to be on the increase. The fungus *Cercospora* Sp. has been found associated with diseased tissues. Disease incidence was found to be comparatively much more in open exposed conditions than in shaded

conditions. Of the five arabica varieties, ' Coorgs ', ' S. 795 ', ' S. 288 ', ' S. 333 ' and ' S. 446 ' tested for varietal susceptibility to this disease, the first two varieties showed maximum susceptibility under natural conditions. Observations on the influence of age of the plant material on disease incidence did not indicate any appreciable differences. Spraying with Bordeaux Mixture (different concentrations) checked the disease incidence considerably.

54. In the trial using different fungicidal formulation to assess their relative efficacy in controlling Brown-eye-spot disease, it was observed that Bordeaux Mixture sprays (1.0%) strength were more effective than the other fungicides tested.

55. Attempts at artificial reproduction of ' Kondlie ' disease using different micro-organisms were unsuccessful. In the trials conducted to study the influence of application of artificial fertilizers and Bordeaux mixture on the incidence of the malady, observations showed that, a high disease incidence was correlated to frequent applications of Bordeaux Mixture, whereas application of fertilizers by themselves did not indicate any possible influence on the disease incidence. Of the 3 arabica varieties, ' Coorgs ', ' Kents ' and ' S. 333 ' tested for varietal susceptibility, though all the three were found to be susceptible, variety ' Kents ' showed the minimum susceptibility. Further elaborate trials on the various aspects of this malady are in progress during the current season. Till July end, in none of these trials, disease incidence was observed.

56. Sclerotium disease of coffee caused by *Sclerotium Cofficola* Stahel., has been recorded for the first time in India.

57. A new type of ' die-back ' of particularly the tertiary branches has been observed during 1959–60 summer months particularly in the South-West Monsoon areas. The malady is more pronounced in open exposed conditions and on lighter soils. Malformations of leaf and branch growth, internal necrosis of tissues of stem, root, leaf petiole, etc., and blossom failures have also been met with. Different micro-organisms (*Collectotrichum* being the predominant one) have been found associated with ' die-back ' affected twigs. Attempts at the artificial reproduction of disease symptoms have so far been unsuccessful. Detailed investigations as to the possible cause of this malady and its control are in progress.

B. DETAILED SECTION REPORTS

I. AGRONOMY

During the year Research in Agronomy Division underwent a period of reappraisal with a view to change certain aspects of its programme. New and long-term experiments on regional basis, to evaluate manurial requirements, spacing required for arabica coffee and varietal performance are being initiated at the existing Regional Field Stations.

Certain long-term experiments which were in progress are being continued with modification in the collection of data so that more critical information may accrue from them. These consisted of studies on the several cultural and soil management practices, studies on manuring robusta with and without pruning and the effect of mulching-cum-manuring on young arabica coffee.

Studies on the estimation of crop and growing of coffee on Brazilian System are being continued. Preliminary investigations on transpiration with different species of coffee were undertaken. Further, germination studies with arabica and robusta were also taken up using different hormones. Intensive cultivation trials were started in the two Research Stations in 1960 with the object of obtaining sustained higher production.

FIELD EXPERIMENTS

I. Studies on the Influence of varying Soil Cultivation Practices on the yield of Arabica Coffee

(*a*) *Soil Cultivation Experiment—Coffee Research Station, Balehonnur :* This trial started in July 1954 on old arabica coffee was continued and so far six years yield data have been accumulated. The yield data of the experiment are given in Table A-I.

The different methods of soil cultivation employed in this experiment have not given any significant result including the current year. A study of the mean average yields for the past five years showed that the set of trenching and renovation pitting treatments were numerically superior to the digging treatments including control. During this year comparison of yields within treatments revealed that trenching $\frac{3}{4}' \times \frac{3}{4}' \times 5'$ was numerically superior to the rest of the treatments including control. The experiment is being continued.

(*b*) *Soil Management Experiment—Coffee Research Station, Balehonnur :* This experiment started in July 1954, with two different depths of digging in three seasons of the year was continued. The yield of coffee both cherry and clean for the past five years are presented in Table A-II.

The yield responses from different treatments for the past five years have not shown any significance. However, the study of the mean average yields for the past five years showed that light digging in November appeared to be the best.

NOTE : The experiments on soil cultivation and management, again confirmed the earlier findings that the treatments did not influence to any appreciable degree the productivity of the plant consistently. In order to investigate the reasons why such treatments were not giving significant results, growth studies and soil moisture assay under different treatments were undertaken at the Coffee Research Station. The preliminary growth studies revealed that different treatments have definite influence on the vegetative growth of coffee in relation to the moisture status during critical periods. The soil cultivation treatments and the resultant moisture conservation appears to give continuous flushing in these plots when compared with low moisture level during hot weather period. But the spray programme was not so far considered in relation to the flush production in these treatments and spray schedule was in conformity with the estate practice, namely, two rounds only. Thus the flush produced at different periods under different soil cultivation practices was found to be affected by leaf disease especially after October period. Perhaps the treatment effects were masked due to inadequate disease protection measures. In the light of this observation made it is proposed to continue these experiments by drawing suitable schedule of spraying according to the growth, rather than mere two or three rounds for all the treatments.

The growth and soil moisture assay data are given in Table A-II (*a*).

II. Manurial Experiment on Robusta

Coffee Research Station, Balehonnur : The manurial trial which was laid out in the year 1951 was continued without any modifications.

The yield data of the experiment are furnished in Table A-III.

The results obtained during the past, including the current year, were not significant. However, the plots receiving 80 lb. N had given numerically higher yield during the previous two seasons. Contrary to this trend the yield records obtained during this season showed that the plot receiving 40 lb. N was numerically superior than other treatments. The experiment is being continued.

III. Robusta Manurial and Pruning Experiment

Bhadra Estate, Balehonnur : The details of the experiment underwent no modification and was continued.

The two levels of Nitrogen, namely, 40 lb. and 80 lb. to an acre were applied in two split equal doses during pre-blossom and post-monsoon periods. The levels of phosphoric acid and potash at 30 and 40 lb. to the acre respectively were applied to all the plots during post-monsoon season. Pruning was carried out in pre-blossom period. The yield data of the experiment are given in Table A-IV.

The yield data for the past eight years, including the current season, did not give significant results. However, the plots receiving 40 lb. N. with no pruning gave numerically higher yield during the current season. This trend compares with the results obtained at Coffee Research Station.

The experiment is being continued.

IV. Experiment on the Influence of Topping on Growth and yield of Robusta Coffee

Byregudda Estate, Balehonnur : This experiment was laid out at Byregudda Estate, Balehonnur in the year 1951 to study the effect of topping robusta plants at 3 feet (91.5 cms.) and 4 feet (122 cms.) heights respectively. The growth responses recorded, though showed better growth at 3′ topping in the initial years, did not continue its superiority and became more or less on par with the other treatment when once the coffee had closed in.

The yield data are furnished in Table A-V. The yield differences during the year were not significant. Out of the five years period of the experiment the first four years recorded numerically higher yields for the plants topped at 4 feet height while during the current year the plants topped at 3 feet height gave numerically higher yield. The experiment is being continued.

V. Mulching Trials on Young Arabica Coffee

Two trials started during the year 1957 were continued.

(*a*) *Mulching experiment :* Coffee Research Station, Balehonnur.

The green manure and cover crops used in the trial were *Crotalaria anagyroides* and *Calopogonium mucunoides* respectively. The green manure crop was cut periodically to a height of about 18″ and cuttings used as a mulch to the coffee. The yield data and growth measurements are furnished in Table A-VI.

The results during the 3rd crop year were not significant. However, the plot mulched with dry leaves at 3 tons per acre gave numerically higher yield during this year. The growth measurements in terms of stem girth did not show any significant difference under various treatments.

(*b*) *Mulching-cum manurial experiment—Coffee Research Station, Balehonnur :* As mulch material, cherry husk and dry leaves were applied at 3 tons per acre in December 1959. The two levels of 20 : 30 : 40 and 40 : 30 : 40 NPK fertilizers were applied in two doses one pre-blossom and the other during post-monsoon period. The yield data and growth measurements are furnished in Table A-VII.

The results during this third crop year were not significant. However, a study of the mean yields indicated that 40 : 30 : 40 NPK mixture application without addition of any mulch material, was superior to other treatments during this year. The experiment is being continued.

VI. Studies on crop estimation

The study was continued on the lines detailed in earlier reports. The estimates of crop based on the complete stripping technique are furnished in Table A-VIII.

From the results it was observed that the actuals were showing certain divergence to the estimated crop obtained by stripping technique. Perhaps these variations may be due to the incidence of ' Die-Back complex ' at varying degrees which might have masked the results, by presenting a heterogenous plant population. However, the study is being continued by the collection of additional information on ' Die-Back ' incidence in these selected estates.

VII. Brazilian system of planting

Coffee Research Station, Balehonnur : One acre of coffee under the modified Brazilian method of planting was continued without any further modification and the yield data were recorded for the two treatments, *viz.*, A-pits completely filled at the time of planting and B-pits half filled at the time of planting. It was found that there was no difference between the two treatments employed. The experiment is being continued.

VIII. Robusta rehabilitation trial

Coffee Research Station, Balehonnur : This observational trial started in the year 1958 was continued. During the current season a light pruning was carried out after the crop harvest. Further, cleaning of renovation trenches and regulation of shade were attended to in these blocks. The rate of manuring was 80 : 60 : 80 NPK and applied in three doses during pre-blossom, pre-monsoon and post-monsoon periods. Other operations like weeding, suckering etc., were in conformity with the estate practices. The yield data for the blocks are given below.

Name of the block	Yield of ripe cherry in lbs. per acre	Yield of clean coffee in cwt./acre
1. Crawford area	1235	2.20
2. J. Block	1315	2.34

The low yields recorded in these blocks during this year may be attributed to the poor set and rainy conditions on the blossom day. The trial is being continued.

IX. Intensive cultivation trial—Old arabica

Coffee Research Station, Balehonnur : An intensive cultivation trial was started during January 1960 with the object of building up the plant vigour for higher production.

(1) Emphasis was given for spraying every three pairs of new leaves formed to keep the leaf disease incidence and the resultant leaf fall at its minimum.

(2) Basal dressing of rock phosphate at 10 cwts. per acre was incorporated during July 1960.

(3) Regular manuring of NPK mixture will be applied in four split doses. The requirement of these plant foods is being evaluated each quarter.

(4) No soil cultivation will be done except for long renovation trenches.

(5) Weeding, suckering etc., will be done as and when necessary.

As on July 31st, three rounds of spraying were completed in these blocks. The leaf disease position so far is at its minimum. Yield will be recorded from these blocks and compared against previous averages.

X. Transpirational studies on coffee

Experiments were conducted to assess the rate of transpirational loss from (1) fungal infections, (2) from lower and upper surface of leaves, (3) from different species and varieties of coffee and (4) from Bordeaux Mixture sprayed leaves. In these experiments the water loss during day and night periods were also assessed. The experimental procedure and the preliminary results achieved were published in the *Indian Coffee*, January 1960. The summary of results are as follows :—

(1) In the case of *Coffea arabica* it was observed that 34.1% of water loss by transpiration, in 24 hours period, occurred from upper surface of leaves.

(2) Seedlings affected by leaf disease and brown-eye-spot transpired 154.41 and 124.3 per cent respectively more water than healthy arabica seedlings, although the area of fungal infection was less than 10% to the total leaf area.

(3) *Coffea liberica* transpired more than *C. canephora*, *C. arabica* and *C. excelsa* in the order stated. Of the two commercial species tested, *C. canephora* and *C. arabica*, the former registered higher transpirational loss than the latter.

(4) Spraying both surfaces of leaf of arabica coffee with 2 : 2 : 40 Bordeaux Mixture checked the rate of transpiration effectively when compared with the treatments of upper surface spraying, lower surface spraying and control.

XI. Studies on the germination and emergence of coffee seeds

Coffee Research Station, Balehonnur : Experiments to evaluate the germination and emergence of seeds in the nursery beds subjected to different treatments were under study. The results of germination experiments, being in the nature of discrete variates, statistical analysis were made with transformed data.

(*a*) *Methods of drying seed coffee and their effect on germination :* Seeds treated with ash and without it, drying seed coffee under shade and in the sun and their effect on

germination was studied during the sowing season. The seeds of arabica coffee were dried to 12 to 13% moisture content in all the above methods.

Treatments :	A :	Sun dried without ash	— Sown with parchment cover.
	B :	Sun dried with ash	— Sown with parchment cover.
	C :	Sun dried without ash	— Sown without parchment cover.
	D :	Sun dried with ash	— Sown without parchment cover.
	E :	Shade dried without ash	— Sown with parchment cover.
	F :	Shade dried with ash	— Sown with parchment cover (Estate practice).
	G :	Shade dried without ash	— Sown without parchment cover.
	H :	Shade dried with ash	— Sown without parchment cover.

The results are presented in Table A-X.

Perusal of the data show that treatments are highly significant at 1% level. Shade drying is significantly superior to sun drying. Treatments F (control) G and H did not show any significant difference among themselves, but were significantly superior to the rest of the treatments. Amongst the treatments A, B, C, D and E, treatments, E, D and C were significantly superior to the treatments B (sun dried with ash and sown with parchment cover) and A (sun dried without ash and sown with parchment cover). Treatments E (shade dried without ash and with parchment cover) D (sun dried with ash and sown without parchment cover) and C (sun dried without ash and sown without parchment cover) did not show any significance among themselves. Likewise the treatments A (sun dried without ash and sown with parchment cover) and B (sun dried with ash and sown with parchment cover) were not significant.

Summarising the results it is found that to obtain maximum percentage of early emergence it is better to sow shade dried seeds (without mixing ash) without parchment cover.

(*b*) *Germination of arabica and robusta seeds as influenced by method of drying and time of sowing :* Seeds of arabica and robusta were prepared in the usual manner with ash. These were dried under shade and in the sun to a constant moisture level. Monthly sowings were undertaken from January to April in the case of arabica and February to April in the case of robusta. The seeds dried in the above two methods were sown with and without parchment cover in a randomized replicated trial with five replications. The collected data of germination percentages were subjected to statistical analysis separately for arabica and robusta. The results are presented in Table A-IX (*a*) and IX (*b*).

In respect of arabica, treatments were highly significant under individual monthly sowings. In all the months the percentage of germination under the treatment D (shade drying without parchment cover) was consistently superior to rest of the treatments. Taking into consideration individual monthly sowings the percentage of germination was better in January and March. February and April sowings were very poor.

(i) *January sowing :* The treatments D (shade dried without parchment cover) and C (shade dried with parchment cover) did not show significance between themselves. But

these were highly significant to the other two treatments, *viz.*, A (sun dried with parchment cover) and B (sun dried without parchment cover). The treatment B was again highly significant to treatment A.

(ii) *February and April sowing :* The treatments A (sun dried with parchment cover), B (sun dried without parchment cover), C (shade dried with parchment cover) and D (shade dried without parchment cover) showed significant differences among themselves, the treatment D registered high percentage of germination followed by C, B and A in the order stated.

(iii) *March sowing :* The treatments C (shade dried with parchment cover) and D (shade dried without parchment cover) while showing significant differences between themselves, were also significantly superior to treatments A (sun dried with parchment cover) and B (sun dried without parchment cover). However there was no significant difference between treatments A and B.

In respect of robusta sowing in the month of March registered high percentage of germination. Here again the treatments D (shade dried without parchment cover) and C (shade dried with parchment cover) gave consistently superior germination percentage when compared with the other treatments. In all the three months of sowing there was no significant difference between the treatments C and D. Taking into consideration the treatments A (sun dried with parchment cover) and B (sun dried without parchment cover) there was no significant difference between them from February and April sowings. However, the treatment B (sun dried without parchment cover) showed significance over the treatment A (sun dried with parchment cover) for March sowing.

It may be concluded from the above results that by employing the methods of shade drying and sowing seeds without the parchment cover are advantageous both in the case of arabica and robusta to obtain high percentage of germination under the nursery conditions. January sowing in the case of arabica and March sowing in the case of robusta appear to give higher germination percentages.

(*c*) *Pre-treatment of seeds :*

(i) *Effect of hot and cold water on emergence of Arabica Coffee seeds.*—Seeds of Arabica Coffee without parchment cover were pre-soaked in cold and hot water for 48 and 96 hours. The seeds were sown on 1st February 1960 in a randomized replicated trial with six treatments and five replications. The number of seeds sown per treatment was 50. The results of the experiment are furnished in Table A-X.

The treatments were significant and no emergence was noticed after 8th week from the date of sowing. From the recorded data it is seen pre-soaking seeds in cold water for 96 hours and 48 hours did not show any significant difference between themselves. But the treatment C (seeds soaked in cold water for 96 hours) showed significance over the rest of the treatments. However there was no significant difference between treatments A (seeds soaked in cold water for 48 hours) and B (seeds soaked in hot water for 48 hours). When taking into consideration the treatments B (seeds soaked in hot water for 48 hours), D (seeds soaked in hot water for 96 hours), E (seeds soaked in cold water till emergence) and F (seeds soaked in hot water till emergence) there was no significant difference among themselves.

(ii) *Effect of hormones on the emergence of arabica seed coffee :* A preliminary study is being carried out to find out the effect of hormones in varying concentrations on the emergence of seed coffee. The results recorded in this experiment are suggestive that pre-soaking seeds in different hormones appears to give early emergence by two weeks when compared with untreated controls. The seedlings from different treatment combinations have been transplanted to the secondary beds for further follow-up hormone treatments to study their growth habits. The results of these experiments will be reported later.

XII. 'Die-Back' Project

(*a*) *Physiological approach :* As one of the many approaches in solving the 'Die-Back' complex emphasis was laid on the retention of satisfactory foliage. It was also thought that, following rigidly the proven agronomical practices, may throw some light on this problem.

Towards this end 'Result Demonstration Blocks—Project Die-Back' 5 acres in extent were started during January–February 1960 at the following estates :—

I. *Saklespur Liaison District.*—
   - A. Sulugode Estate.
   - B. Wartyhally Estate.
   - C. Kithlemane Estate.
   - D. Dodlakunda Estate.
   - E. Cheekanahally Estate.

II. *Chickmagalur Liaison District.*—
   Chikli Estate.

The above project will be carried out for a period of five years in the first instance.

Programme : (1) *Manuring.*—The manurial schedule will be of complete NPK mixture applied in three or four doses. The requirement of these plant foods is being evaluated each quarter. As a soil amendment basal dressing of rock phosphate at 10 cwts. per acre is being incorporated.

(2) *Spraying :* 0.5 *per cent neutral Bordeaux Mixture.*—The spray programme is envisaged to give maximum protection to the leaves formed in the susceptible coffee. To achieve this maximum protection these blocks are being sprayed as and when 2 to 3 pairs of new leaves are formed after the previous spray.

(3) *Agronomic practices.*—Agronomic practices like suckering, weeding and trenching are being undertaken regularly.

(4) *Shade :* The present stand of shade and the response of plant material under them are being studied for the season. Further, it is contemplated to maintain comparatively thick shade in these blocks to avoid overbearing during the recovery period.

(5) Regular borer, green bug, etc., control measures are being undertaken in these blocks.

Progress : So far, from the commencement, these blocks have received two rounds of spray and two rounds of manuring. Shade lopping of dadaps was done during May–June 1960 in the blocks wherever overhead shade was satisfactory. In certain other blocks where this condition was not satisfactory only regulation of dadaps and late lopping were done. On the whole these blocks are showing satisfactory recovery from the earlier attack of ' Die-back '

(*b*) *Malformations and virus-like symptoms in Coffea arabica :* The malformations are generally seen in *C. arabica* associated with internal tissue necrosis. To study this aspect and to eliminate the possibilities of virus infection theory, the following transmission studies have been undertaken by the division.

(1) *Mechanical transmission :* The leaves and twigs of the severely affected necrotic bushes were collected and the expressed plant sap was inoculated by pin pricks and blade injuries. The treated plants are under observation.

(2) *Reciprocal grafts :* Grafts were done during June–July 1960. Majority of the grafts of healthy scion on abnormal and necrotic stock plants have so far failed to make successful union. On the other hand the suckers obtained from necrotic plants grafted on to healthy stock appears to have taken up satisfactory union. It will be too early to predict about the success of these grafts and it may take anywhere between 18 months to 3 years before any opinion can be ventured on this aspect.

XIII. Agronomical studies on ' Kondlie '

1. To study the malady, artificial induction of insanitary conditions like overwatering crowding of seedlings, thick shading, no shading, no spraying are under observation. Irrespective of the varied treatments arabica seedlings showed during July period splitting of superficial green tissues with brown streaks of no regular pattern. So far neither collar-rot nor ' Kondlie ' symptoms have been noticed in these beds.

2. A batch of seedlings definitely showing ' Kondlie ' symptoms collected from secondary nursery beds were transplanted into baskets during January 1960, covering the constricted portion with sufficient soil. Periodical examination showed that the seedlings have struck root just above the constriction point and continued to grow satisfactorily. During July 1960 some of the plants when examined showed phloem necrosis of terminal shoot and roots. Further observations are in progress.

XIV. Irrigation

A Perrot overhead sprinkler irrigation unit which was imported from West Germany became available for use during the later half of January 1960. No specific study could be taken up pending certain preliminary caliberations and calculations. However this sprinkling unit was used to irrigate the robusta and arabica coffee in the month of February–March 1960 in blocks where moisture stress was noticed. The following are the preliminary observations made :—

(1) In the case of robusta, sprinkling of 1½ inches of artificial rain in February–March opened the blossom ; the period of blossoming ranging from 7 to 9 days. The blossoms were

uniform and set and development are satisfactory. Bee activity in these blocks were above normal on the blossom day.

(2) On the other hand sprinkling, 1½ inches of artificial rain on old arabica did not bring about a uniform blossom. A trend towards a running blossom was noticed in these blocks. However the set and development of berries are satisfactory.

(3) It will also be a point of interest that leaf disease susceptible bushes with full leaf complement and supplies of station selections responded erratically to sprinkler irrigation.

(4) Sprinkled old arabica coffee was observed to put forth new flush earlier than non-sprinkled blocks and thus fresh incidence of leaf disease was noticed during February, March and April.

(5) In the case of late January and early February, sprinklings of 1 inch of artificial rain, paddying of flower buds in stray cases especially in open patches were noticed.

XV. Weedicide trials

A preliminary weedicide trial was laid out during September 1959 using the following weedicides.

(1) Weedone : LV4
(2) Weedone Brush Killer
(3) Weedar 64
(4) Dowpon.
(5) P.C.P.
(6) 2, 4-D
(7) 2, 4, 5-T

Observations : The chemicals 1 to 3 were observed to be slow in action. The broad leaved soft weeds showed signs of wilting and scorching within a week after spray application. But complete killing was not obtained and fresh weeds were noticed in these plots after a duration of 4 to 6 weeks. In general 2, 4-D was found to be effective against succulent types of weeds while 2, 4, 5-T against woody types of weeds. ' Dowpon ' alone (at C.R.S.) and Dowpon in combination with other chemicals (at C.R.S.S.) showed best response in the eradication of grasses. No fresh growth of grasses was noticed in these treatments but other weeds started growing ranging from 3 to 6 months period after the spray application of chemicals. It is also interesting to note that wherever Dowpon was used either alone or in combination with other weedicides complete defoliation of Dadaps was noticed from the second month onwards after the spray application. The plots treated with Dowpon in combination with other weedicides like P.C.P. ; 2, 4-D and 2, 4, 5-T showed phytotoxic effect on coffee in stray cases.

With these preliminary results, detailed experiments using Dowpon with different concentrations and time of application were laid out at C.R.S., C.R.S.S. and in three other Liaison districts. The treatments are as follows :

A : 5 lb. of Dowpon in 200 gallons per acre—Pre-monsoon application.
B : 10 lb. of Dowpon in 200 gallons per acre—Pre-monsoon application.
C : 5 lb. of Dowpon in 200 gallons per acre—applied in split doses.
D : 10 lb. of Dowpon in 200 gallons per acre—applied in split doses.
E : 5 lb. of Dowpon in 200 gallons per acre—applied in August.

F : 10 lb. of Dowpon in 200 gallons per acre—applied in August.

G : No application—Control—Estate practice.

NOTE—C and D, Dowpon is applied in split doses—half the quantity in pre-monsoon and the balance in August break in the monsoon.

E and F are applied in one dose in August.

The effect of Dowpon on grass, coffee and associated Dadap and other shade trees will be studied critically.

XVI. Experiments at Coffee Research Sub-station, Chethalli

1. *Soil Cultivation experiment :* A trial similar to the one laid out at the main station [*vide* I-(*a*)] which was started in the year 1953 was continued. Different methods of soil cultivation such as trenching, renovation pitting, light and deep digging during October–November period are under comparison against control which is only weeded. The yield data of the experiment are given in Table A-XI.

The yield differences for the past six years had not given any significant results. So far conflicting results were obtained from year to year. But during the current season the treatments gave significant result at 5% level. The treatments, light digging and renovation pitting were significantly superior to the rest of the treatments including control. However there was no significant difference between light digging and renovation pitting. The other treatments, trenching $1\frac{1}{2}$ feet deep, trenching $\frac{3}{4}$ foot deep, deep digging and control were not significant among themselves. This result is being critically examined for future observation and studies.

2. *Studies in the shade requirements of arabica coffee :* In pursuance of the resolution of 36th Research Committee, this experiment was discontinued.

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Agronomist

TABLE A-I

Soil Cultivation Experiment

Locality : Coffee Research Station, Balehonnur.
Design : Randomized Blocks.
Treatments : Six.
Plots size : 4 × 20. 80 Plants (4.5 cents).
Total area under experiment : 1.08 acres.

Year of commencement : 1954/55.
Replications : 4.
Variety : Coorgs Arabica.
Age : 30 years.
Spacing : 5′ × 5′.

Sl. No.	Treatments	Mean yield of calculated ripe Cherry in lbs. per acre						Average for five years	Mean yield of calculated clean coffee in cwts. per acre						Average for five years
		1954–55	1955–56	1956–57	1957–58	1958–59	1959–60		1954–55	1955–56	1956–57	1957–58	1958–59	1959–60	
A	Trenching 1½′ × ¾′ × 5′	3,204	4,779	2,097	4,058	3,785	1,202	3,184	5.27	7.22	3.34	6.23	5.63	1.78	4.84
B	Trenching ¾′ × ¾′ × 5′	4,092	3,030	2,609	5,195	5,008	1,229	3,414	6.85	4.40	4.10	7.97	7.45	1.82	5.15
C	Renovation pitting 1½′ × ¾′ × 3′ ...	3,673	3,382	3,475	3,719	4,642	1,065	3,257	5.95	5.28	5.65	5.53	6.91	1.58	4.99
D	Deep digging—November	3,872	3,273	2,909	4,270	4,102	764	3,064	6.05	5.25	4.45	6.55	6.10	1.13	4.69
E	Light digging—November ...	3,855	2,798	2,739	3,618	4,990	972	3,023	6.56	4.29	4.30	5.55	7.43	1.44	4.60
F	Control (Weeding only).	3,873	3,147	3,046	3,477	3,938	899	2,091	6.38	4.83	4.78	5.17	5.86	1.33	4.39
	General mean ...	3,762	3,397	2,811	4,056	4,411	1,022	3,140	6.18	5.20	4.43	6.17	6.56	1.51	4.77
	S.E.M.	588.7	477.4	354.3	445.4	485.0	234.1	...	...	...	...	...	...	...	...
	Significance	Basic	No	No	No	No	No								
	Conclusion	...	...	...	...	...	$\overline{\text{BACEFD}}$								

TABLE A-II

Soil Management Experiment

Locality : Coffee Research Station, Balehonnur.
Design : Randomized Blocks.
Treatments : Seven.
Plot size : 5 × 16 = 80 plants (4.5 cents).
Age : 30 years.

Year of commencement : 1954–55.
Replications : 4.
Variety : Coorgs Arabica.
Area under experiment : 1.2 acres.
Spacing : 5′ × 5′

Sl. No.	Treatments	Mean yield of calculated ripe Cherry in lbs. per acre						Average for five years	Mean yield of calculated clean coffee in cwts. per acre						Average for five years
		1954–55	1955–56	1956–57	1957–58	1958–59	1959–60		1954–55	1955–56	1956–57	1957–58	1958–59	1959–60	
A	Deep digging—August	6,698	5,790	1,972	4,003	4,276	737	3,356	10.65	8.89	3.05	6.33	6.36	1.09	5.14
B	Light digging—August	6,175	7,054	2,393	4,004	4,057	819	3,665	10.34	10.04	3.59	6.33	6.04	1.21	5.44
C	Deep digging—November	4,949	6,373	1,757	4,752	4,362	668	3,582	8.01	9.78	2.74	7.18	6.49	0.99	5.43
D	Light digging—November	5,842	7,232	2,192	4,026	4,336	897	3,737	9.78	10.99	3.36	6.08	6.45	1.33	5.64
E	Deep digging—April ...	5,543	6,368	1,743	4,329	4,362	856	3,532	9.12	9.06	2.71	6.54	6.49	1.27	5.21
F	Scuffling—April ...	4,451	5,573	1,644	4,616	3,521	928	3,256	6.96	8.71	2.48	7.40	5.24	1.37	5.40
G	Control (Weeding only).	6,151	5,184	2,560	3,830	4,349	853	3,355	9.96	7.60	4.08	5.98	6.47	1.26	5.08
	General mean ...	5,687	6,225	2,037	4,222	4,180	823	3,497	9.26	9.29	3.14	6.55	6.22	1.22	5.28
	S.E.M.	540.7	740.8	237.6	593.0	381.4	141.3	...	...	...	...	...	...	...	...
	Significance	Basic	No	No	No	No	No	...	...	...	...	...	...	...	...
	Conclusion	...	...	...	...	...	...	FDEGBAC							

TABLE A-II (*a*)

Soil Cultivation Experiment

Studies on growth and moisture level

Treatments	Average number of pairs of leaves formed		Moisture percentage recorded during February 1960
	May Initial	June	
A. Trenching : $1\frac{1}{2}' \times \frac{3}{4}' \times 5'$	33.2	35.0	5.29
B. Trenching : $\frac{3}{4}' \times \frac{3}{4}' \times 5'$	24.0	26.0	5.75
C. Renovation pitting : $1\frac{1}{2}' \times \frac{3}{4}' \times 3'$ ...	22.1	24.0	4.89
D. Deep digging in November	23.5	26.0	9.57
E. Light digging in November	29.9	36.0	7.28
F. Control (weeding only)	22.3	24.0	2.80

TABLE A-III

Manurial Experiment on Robusta

Locality : Coffee Research Station, Balehonnur.
Design : Randomized Blocks.
Treatments : Three.
Total area under experiment : 0.85 acres.

Year of commencement : 1951–52.
Replications : Six.
Plot size : Gross—4 × 8 = 32 plants.
Net— 2 × 6 = 12 plants.

Treatments	Calculated mean yield of ripe Cherry in lbs. per acre									Calculated mean yield of clean coffee in Cwts. per acre								
	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1959–60	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1959–60
A. Manured at NPK 40 : 30 : 40 ...	1,793	2,427	3,231	2,494	4,099	2,724	4,118	3,220	2,053	3.02	4.78	6.01	4.01	7.78	5.11	7.85	5.75	3.05
B. Manured at NPK 80 : 30 : 40 ...	1,804	2,175	2,710	2,338	4,932	2,452	5,705	3,465	1,551	3.27	4.35	4.64	3.76	9.26	4.60	10.88	6.19	2.30
C. Control—No manure ...	1,331	2,333	3,231	2,254	4,826	2,145	4,864	2,719	1,627	2.44	4.60	5.41	3.62	9.06	3.83	9.00	4.82	2.42
General Mean ...	1,625	2,311	3,057	2,362	4,619	2,440	4,896	3,135	1,744	2.91	4.58	5.35	3.80	8.70	4.51	9.24	5.59	3.88
S.E.M. ...	...	231.8	392.1	259.0	386.6	261.2	505.0	387.7	46.45									
Significance ...	Basic	No	No	No	No	No	No	No	No									
Conclusion ...									ACB									

TABLE A-IV

Robusta Manurial and Pruning Experiment

Locality : Bhadra Estate, Balehonnur.
Design : Latin Square.
Treatments : Six
Plot size : Gross 6 × 10 = 60 plants (8.8 cents).
Net 4 × 8 = 32 plants (4.7 cents).

Year of commencement : 1952–53.
Replications : Six.
Total area under experiment : 3.17 acres.

Treatments	Calculated mean yield of ripe Cherry in lbs. per acre								Calculated mean yield of clean coffee in cwts. per acre							
	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1959–60	1952–53	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59	1959–60
A. Control (No manure) ...	3,836	3,417	4,178	3,340	5,465	3,411	5,784	2,262	6.80	5.49	7.09	5.67	10.25	6.24	10.33	3.36
B. Pruned (No manure) ...	3,586	3,346	3,889	3,657	5,507	3,747	5,907	2,550	6.31	5.67	7.31	5.88	10.33	6.85	10.59	3.79
C. Manured—NPK at 40 : 30 : 40	3,707	3,705	3,687	4,739	5,100	3,262	6,204	3,008	6.48	5.96	6.91	8.89	9.56	6.02	11.08	4.47
D. Manured—NPK at 80 : 30 : 40	4,038	3,623	4,133	4,232	5,236	3,616	6,655	2,951	7.10	5.39	7.75	7.56	9.82	6.78	11.88	4.39
E. Manured—NPK at 4 : 30 : 40 + pruned ...	4,265	3,664	5,046	4,623	5,178	3,574	6,937	2,536	7.49	5.89	10.36	9.08	10.17	6.71	12.39	3.77
F Manured—NPK at 80 : 30 : 40 + pruned	3,925	3,665	4,164	4,677	4,928	3,609	7,773	2,504	6.79	6.68	7.81	8.77	9.68	7.05	13.88	3.72
General Mean ...	3,893	3,570	4,183	4,212	5,235	3,537	6,543	2,635	6.81	5.88	7.87	7.64	9.97	6.61	11.68	3.92
S.E.M. ...	693.7	432.2	421.5	425.8	429.1	300.9	634.5	65.9	...	...	...	...	...	...	...	...
Significance ...	Basic	No	No	No	No	No	No	No.	...	...	...	...	...	...	...	...
Conclusion ...	...	...	...	...	...	...	...	... CDBEFA								

TABLE A-V

Robusta Topping Experiment : Byregudda Estate, Balehonnur

Locality : Byregudda Estate, Balehonnur.
Design : AB BA Pattern.
Treatments : Two
Replications : Twelve

Year of commencement : 1951–52
Plot size : 4 × 8–32 Plants
Spacing 9′ × 9′

Treatments	Calculated mean yield of Ripe Cherry in lbs. per acre				
	1955–56	1956–57	1957–58	1958–59	1959–60
A. Topped at 3 ft. height ...	469	532	1285	2101	529
B. Topped at 4 ft. height ...	668	654	1337	2402	452
General Mean ...	568	593	1311	2251	490
S.E.M. ...	77.7	46.6	271.8	242.0	34.25
Significance ...	No	No	No	No	No
Conclusion ...					$\overline{AB}$

TABLE A-VI

Mulching Experiment

Locality : Coffee Research Station, Balehonnur.
Design : Randomized blocks.
Treatments : Six.
Replications : Four.
Year of commencement : 1956–57.
Variety : Arabica Selection.
Total area under experiment : 0.68 acres.
Plot size : Gross ... 35 plants (2.89 cents)
Net ... 15 plants (1.24 cents)

Sl. No.	Treatments	Mean stem girth measurement in cms.					Yield of ripe cherry in lbs. per acre		
		1957	1958	1959	1960	Increase over previous year	1957–58	1958–59	1959–60
A.	Control (No mulch) ...	1.5	2.1	3.3	3.7	0.4	61	828	2302
B.	Mulching with dry leaves at 3 tons per acre ...	1.4	2.0	3.2	3.3	0.1	68	667	3063
C.	Mulching with cherry husk at 3 tons per acre ...	1.7	2.4	3.5	3.5	0.0	95	1461	2465
D.	Cover cropping ...	1.5	2.2	3.0	3.2	0.2	174	1195	2341
E.	Green manure before monsoon ...	1.3	2.1	3.0	3.5	0.5	118	907	2107
F.	Green manure after monsoon ...	1.3	2.0	2.8	3.1	0.3	47	682	2471
	General Mean ...	1.4	2.1	3.1	3.4	0.3	94	957	2458
	S.E.M. ...	0.34	0.49	0.67	1.08	...	29.5	302.8	408.4
	Significance ...	Basic	No	No	No	...	...	...	No
	Conclusion ...	...	...	...	ACEBDF				BFCDAE

TABLE A-VII

Mulching-cum-Manurial Experiment

Locality : Coffee Research Station, Balehonnur.
Year of commencement : 1956–57.
Design : Randomized Blocks.
Variety : Arabica Selection.
Treatments : Six.
Total area under experiment : 0.68 acres.
Replications : Four.
Plot size : Gross ... 35 plants (2.89 cents).
Net ... 15 plants (1.24 cents).

Sl. No.	Treatments	Mean stem girth measurement in cm.					Calculated yield of ripe cherry in lbs. per acre		
		1957	1958	1959	1960	Increase over previous year	1957–58	1958–59	1959–60
A.	Manured NPK at 20 : 30 : 40 ...	1.4	2.3	3.3	3.9	0.6	393	2193	2308
B.	Manured NPK at 40 : 30 : 40 ...	1.2	2.1	3.3	3.7	0.4	197	1886	3063
C.	Manured as in A plus dry leaf mulch at 3 tons per acre ...	1.4	2.5	3.5	3.9	0.4	690	4047	2465
D.	Manured as in B plus dry leaf mulch at 3 tons per acre	1.3	2.4	3.4	3.8	0.4	742	2361	1873
E.	Manured as in A plus cherry husk mulch at 3 tons per acre ...	1.5	2.4	3.4	3.9	0.5	371	3071	2109
F.	Manured as in B plus cherry husk mulch at 3 tons per acre ...	1.4	2.4	3.5	4.1	0.6	358	2117	2471
	General Mean ...	1.3	2.4	3.4	3.9	0.5	458	2613	2382
	S.E.M. ...	0.34	0.48	0.58	0.58	...	245.7	816.5	483.4
	Significance ...	Basic	No	No	No	...	Basic	No	No
	Conclusion ...	...	...	...	...	FACEDB			BFCAED

TABLE A-VIII

Crop Estimation Studies 1959–60

Kenyan Pre-harvest—Stripping Method

Sl. No.	Liaison Zone	Estate selected	Estimates and actuals for the selected areas for crop estimation studies				Percentage of difference close to the actuals either in I or II stripping	
			Blossom in tons	I stripping in tons	II stripping in tons	Actual crop picked in tons		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Somwarpet ...	(i) Masgode	7.0	5.0	6.75	7.5	— 10.0	II
		(ii) Madegode	10.0	7.0	9.65	10.0	— 3.5	II
2	Gonicoppal ...	(i) Alitopoo	25.0	70.7	69.6	56.1	+ 24	II
		(ii) Athithope	2.1	4.15	3.57	4.5	— 7.8	I
		(iii) Balmanay	31.0	27.4	27.9	26.0	+ 5.4	I
		(iv) Kondamury	20.75	18.55	15.1	14.45	+ 4.5	II
		(v) Yemmegundi	75.5	40.0	37.05	32.05	+ 15.6	II
		(vi) Hoovinakadu	160.0	179.21	147.4	140.0	+ 5.3	II
3	Mudigere ...	(i) Javali	25.0	14.6	15.35	17.0	— 9.7	II
		(ii) Heggudlu	27.0	15.45	10.75	13.0	— 17.3	II
4	Saklespur ...	(i) Goorgully	30.0	33.35	40.3	24.1	+ 39.0	I
		(ii) Kendanamane ...	8.0	6.6	8.15	5.5	+ 20.0	I
		(iii) Sulugode	15.0	15.5	22.1	33.75	— 34.5	II
		(iv) Biccode	29.0	88.0	138.2	104.68	— 16	I
		(v) Doddalakunda ...	14.0	19.0	18.15	35.0	— 48.1	II

TABLE A-VIII—(*Contd.*)

Sl. No.	Liaison Zone	Estate selected	Estimates and actuals for the selected areas for crop estimation studies				Percentage of difference close to the actuals either in I or II stripping	
			Blossom in tons	I stripping in tons	II stripping in tons	Actual crop picked in tons		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
5	Chickmagalur ...	(i) Vasantcool	28.0	11.0	24.6	20.3	+ 21	II
		(ii) Chandragiri	25.0	30.75	19.35	23.0	− 15.8	II
6	Nilgiris ...	(i) Athigundu	15.0	13.85	11.65	14.0	− 1.0	I
		(ii) Benhope	10.0	9.7	14.75	13.8	+ 7.0	II
		(iii) Mailoor	3.0	5.7	6.15	4.27	+ 33.5	I
		(iv) Glenburn	40.0	34.5	37.6	35.0	− 1.4	I
7	Kottayam ...	(i) Thaliar	6.0	10.5	...	10.0	+ 5.0	I
8	Kalpetta ...	(i) Porkady	6.75	7.25	4.75	4.9	− 3.0	II
		(ii) Padripara	28.25	17.0	17.85	15.93	+ 6.6	I
		(iii) Puliyarmalai	12.5	17.6	18.45	12.37	+ 42.3	I
		(iv) North Carolina ...	5.0	7.75	7.0	5.27	+ 32.8	II
		(v) Puthuthottam	1.1	8.9	7.2	7.75	− 7.0	II
9	Coffee Research Station, Balehonnur		14.75	10.57	10.75	9.25	+ 10.4	I
10	Coffee Research Sub-Station, Chethalli		33.0	14.6	18.55	28.6	−35.1	II

+ Overestimate — Underestimate

TABLE A-IX

GERMINATION STUDIES

Drying of seed coffee in shade and sun and its effect on emergence—Set No. I

Treatments : 8
Design : Randomized.
Replications : 4 *Arabica sown :* On 25th January 1960.
No. of seeds per treatment : 50.

Treatments	Mean percentage of germination	Angle Mean
A. Sun dried without ash sown with parchment cover.	6.0	13.7
B. Sun dried with ash sown with parchment cover ...	4.0	11.0
C. Sun dried without ash sown without parchment cover	43.5	41.2
D. Sun dried with ash sown without parchment cover	45.0	42.1
E. Shade dried without ash sown with parchment cover	54.5	47.6
F. Shade dried with ash sown with parchment cover.	69.0	56.5
G. Shade dried without ash sown without parchment cover	76.0	60.9
H. Shade dried with ash sown without parchment cover	74.5	59.9
General Mean	...	41.6
S.E.M.	...	2.628
Significance	...	Yes*
Critical Difference	...	7.74
Conclusion	...	G H F E D C B A

* Significant at 1% level.

TABLE A-IX (*a*)

GERMINATION STUDIES

SET NO. II—ARABICA—MONTHLY SOWING

Treatments : 4. *Replications :* 4.
Design : Randomized. *Number of seeds per treatment :* 50.

Treatments	Mean percentage of germination of seeds sown on							
	25–1–1960		24–2–1960		25–3–1960		25–4–1960	
	Actual	Sin θ^2	Actual	Sin θ^2	Actual	Sin θ^2	Actual	Sin θ^2
A. Sun drying with parchment cover-intact ...	6.0	13.7	0.8	3.2	9.2	16.9	1.2	4.8
B. Sun drying without parchment cover ...	43.5	41.2	6.4	14.2	11.6	19.4	9.6	17.9
C. Shade drying with parchment cover intact ...	69.0	56.5	38.4	38.0	44.8	42.8	43.2	41.0
D. Shade drying without parchment cover ...	74.5	59.9	48.0	43.8	60.8	51.3	57.2	49.1
General Mean ...	48.5	42.8	23.4	24.8	31.6	32.6	27.8	28.2
S.E.M. ...	...	2.63	...	2.51	...	2.04	...	1.82
Significance ...	...	Yes*	...	Yes*	...	Yes*	...	Yes*
L.S.D. at 5% ...	...	7.75	...	7.74	...	6.32	...	5.82
Conclusion ...	...	$\overline{DCBA}$	...	$\overline{DCBA}$	...	$\overline{DCBA}$	...	$\overline{DCBA}$

* Significant at 1% level.

TABLE A-IX (*b*)

GERMINATION STUDIES

SET NO. III—ROBUSTA—MONTHLY SOWING

Treatments : 4. *Replications :* 5.
Design : Randomized. *Number of seeds per treatment :* 50.

Treatments	Mean percentage of germination of seeds sown on					
	24–2–1960		25–3–1960		25–4–1960	
	Actual	Sin θ^2	Actual	Sin θ^2	Actual	Sin θ^2
A. Sun drying with parchment cover intact	1.2	4.8	2.0	7.16	0.8	3.2
B. Sun drying without parchment cover.	1.2	4.8	31.2	30.46	2.4	5.7
C. Shade drying with parchment cover.	64.0	53.3	86.4	68.66	9.6	17.4
D. Shade drying without parchment cover	64.5	53.7	94.0	76.58	13.6	21.5
General Mean	32.7	29.1	53.4	45.71	6.6	11.9
S.E.M.	...	2.59	...	5.50	...	2.58
Significance	...	Yes*	...	Yes*	...	Yes*
L.S.D. at 5%	...	7.98	...	16.96	...	7.96
Conclusion	...	DCBA	...	DCBA	...	DCBA

TABLE A-X

GERMINATION STUDIES

Effect of cold and hot water for 48 and 96 hours on germination and emergence of seed coffee

Treatments : 6 *Design :* Randomized.
Replications : 5. *Number of seeds per plot :* 50.

Treatments	Mean percentage of emergence	Angle Mean
A. Seeds soaked in cold water for 48 hours	75.6	60.5
B. Seeds soaked in hot water for 48 hours	68.4	55.9
C. Seeds soaked in cold water for 96 hours	80.0	63.6
D. Seeds soaked in hot water for 96 hours	64.8	53.7
E. Seeds soaked in cold water till emergence of radicle ...	57.2	49.2
F. Seeds soaked in hot water till emergence of radicle ...	59.6	50.5
General Mean	67.6	55.5
S.E.M.		2.05
Significance		Yes*
Critical Difference		6.04
Conclusion		C A B D F E

* Significant at 1% level.

TABLE A-XI

Soil Cultivation Experiment

Locality : Coffee Research Sub-Station, Chethalli.
Design : Latins Square.
Treatments : Six.
Replications : Six.
Plot Size : Gross—160 plants.
Net—112 plants.

Year of commencement : 1953–54.
Variety : Coorgs Arabica.
Total area under experiment : 4.80 acres.

Sl. No.	Treatments	Calculated Mean yield of ripe Cherry in lbs./acre						Average of five years	Calculated mean yield of clean coffee in cwts./acre						Average of five years
		1954–55	1955–56	1956–57	1957–58	1958–59	1959–60		1954–55	1955–56	1956–57	1957–58	1958–59	1959–60	
A	Trenching 1½′ deep ...	1,733	1,710	7,001	3,350	3,370	2,905	3,667	2.58	2.54	10.42	4.99	5.01	4.32	5.45
B.	Trenching ¾′ deep ...	1,535	1,680	7,321	3,171	3,035	2,595	3,560	2.29	2.50	10.89	4.72	4.52	3.86	5.29
C	Renovation pitting ...	1,763	1,792	7,136	2,940	3,341	3,072	3,656	2.62	2.67	10.61	4.38	4.97	4.57	5.44
D	Light digging ...	1,358	1,920	7,106	3,127	3,013	3,113	3,655	2.02	2.86	10.57	4.65	4.48	4.78	5.46
E	Deep digging ...	1,613	1,920	7,047	3,526	2,698	2,749	3,658	2.40	2.86	10.48	5.25	4.54	4.09	5.44
F	Control (weeding only).	1,920	1,837	7,847	3,117	2,894	2,608	3,660	2.81	2.73	11.67	4.64	4.31	3.88	5.45
	General Mean ...	1,650	1,810	7,243	3,205	3,058	2,840	3,643	2.46	2.69	10.71	4.77	4.64	4.25	5.41
	S.E.M.	8.89	6.81	1031.4	365.8	494.0	129.68	...	...	...	...	...	...	...	...
	Significance	Basic	No	No	No	No	Yes	...	...	...	...	...	...	...	...
	Critical difference ...	...	...	...	...	...	366.84	...	...	...	...	...	...	...	...
	Conclusion						DCAEFB								

II. BOTANY

Inter and intra-specific coffee breeding to combine resistance to leaf disease (*Hemileia vastatrix B. and Br.*) and high yields were continued. (1) Collection and establishment of species, varieties, types and forms of coffee from countries outside India and South Indian coffee estates, (2) comparative trials on clonal progeny of good bearers and seedling progeny of selections and cross-breds for finding out their behaviour to leaf disease and yields, (3) morphological and cytological studies, (4) examination of seed plots of approved selections for seed collection for supply to growers, (5) experimental and demonstration work on vegetative propagation of coffee by grafting and rooting of sucker cuttings, and (6) collection and establishment of shade tree species from sources in and outside India continued to form the principal work of this Division.

Coffee seeds were obtained during the year by courtesy of (1) Director, Instituto Agronomico Do Estado De Sao Paulo, Campinas, Brazil, and, (2) Director, Institut National pour L'Etude Agronomique Du Congo Belge. Seeds of shade trees were obtained through the courtesy of (1) The Divisional Soil Conservation Officer, Mizo District, Assam, and (2) General Manager, Alternate and Subsidiary Crops, Mungpoo, West Bengal.

A. Coffee Breeding

I. Arabica

1. With a view to evolve leaf disease resistant, high yielding and vigorous strains, cross-breeding of arabica coffee was continued. Twenty-three crosses were effected during the year. Selected plants from K.P. 423—a high yielding Kents arabica selection from Lyamungu Station established at Balehonnur, cultivars Padang, Philippinean, Blue Mountain possessing vigorous growth and good bean characters, Ethiopian collections S. 12 Kaffa, S. 8-Taffarikela, Geisha, and S. 881 and S. 882 (collections from Rume and Barbuk Sudan) exhibiting freedom from leaf disease in the field, were used for cross-breeding with selected plants in the first generation of S. 795 showing resistance to I and II races of leaf disease and low percentage of false polyembryony, and first generation of S. 44 showing resistance to I, II and III races of leaf disease, to improve upon the bean characters of the latter as well as to further fortify their resistance to leaf disease. The selected parent plants were also selfed to raise progeny for comparative tests.

2. *Field Studies of advanced generations of selections and hybrids* : (*a*) The observational trials started in 1952 with the progeny of (i) three plants of S. 795, (ii) one plant of S. 333, and, (iii) 5 intra-crosses of arabica cultures of B.A. Series were pursued. Observations extending over five years on leaf disease susceptibility have indicated that among the S. 795 progeny, one culture has consistently shown low, 5%, leaf disease susceptible segregates and the other two up to 21.6%. These cultures recorded at 2.2 to 4.0 cwt./acre yield during the year. Their average yield over the last four years ranges from 5.8 to 6.0 cwt./acre.

The progeny of S. 333 recorded a yield of 0.8 cwt./acre during the year as against 7 cwt./acre during 1958–59 and 4.9 cwt./acre during 1957–58.

As reported last year, among the five intra-crosses only one (B.A. 21 × B.A. 16) continued to show a low, 9.8%, leaf disease susceptibility in the field. The remaining four intra-crosses show over 25% susceptibility and these have been discarded. The yield of these cultures

has ranged from 1.7 to 3.6 cwt./acre during the year, as against 3.93 to 7.54 cwt./acre during 1958–59 and 2 to 5 cwt./acre during 1957–58.

(*b*) The 1953 series of plantings consist of 11 cross-breds and three hybrid collections from neighbouring estates. Of these, six crosses were discarded last year on the basis of high percentage of leaf disease susceptible segregates. In the remaining five cultures (intra-crosses between B.A. 9, 19, 21 and 23), the susceptible segregates range from 3.8 to 31.1%. The yield of the cultures has ranged up to 1.7 cwt./acre during the year as against 2 to 4.8 cwt./acre during 1958–59 and 0.3 to 4.6 cwt./acre during 1957–58.

The three hybrid collections recorded 14.6% to 32.5% susceptible segregates during the year, as against 15.2% to 36.0% in the previous year. They have continued to give low yields ranging from 0.23 to 0.86 cwt./acre during the year as against 1.9 to 2.6 cwt./acre during 1958–59 and 0.3 to 1.3 cwt./acre during 1957–58.

(*c*) Field observations on leaf disease susceptibility in the progeny of ten intra-crosses between arabica cultures planted in 1954 were continued. Three of these (cross-breds of B.A. 25 with S. 31, S. 288 and S. 446) have continued to remain free from leaf disease in the field since planting. The other seven cultures consisting of crosses between B.A. 13, 19, 22, 25, Kents arabica, 2nd generation of S. 44, and S. 829 and Dvamachy hybrid, have recorded susceptible segregates ranging from 1.1 to 12.5%. The first yield of the ten cultures during the year has ranged from 1.23 cwt./acre to 4.20 cwt./acre.

(*d*) Of the nine intra-crosses between arabica cultures planted in 1955, one, B.A. 22 × B.A. 12, has continued to remain free from leaf disease. F_2 Generation of S. 31 arabica selection cross-bred with Kents arabica which had shown 9.1% susceptible segregates up to last year exhibited 36.5% during the year. The remaining seven intra-crosses exhibited leaf disease susceptibility ranging from 9.5% to 50%. Three of these cultures showing disease susceptibility of over 25% have been discarded.

(*e*) Three out of 16 intra-crosses between arabica cultures planted in 1956 were reported as being free from leaf disease in the previous years. While two continued to be free, the remaining one showed up to 1.7% susceptible segregates. The remaining 13 intra-crosses exhibited susceptibility ranging from 3.6% to 43.4%.

In the six cultures of S. 795 2nd generation planted in 1956, the susceptible segregates ranged up to 16.7%.

(*f*) Only one (B.A. 13 × 1st generation of S. 178) of 12 intra-crosses planted during 1957, has remained free from leaf disease since planting. The remaining crosses have exhibited susceptibility ranging from 1.6% to 28%. Among the cross-breds, the progeny of S. 44 (2nd generation) × S. 795, and 2nd generation of B.A. 25 show markedly vigorous growth.

(*g*) During 1958, ten intra-crosses between the progeny of S. 288, S. 795 and S. 178 and collections from Rume and Barbuk Sudan were planted in the field for study of their field performance. Two crosses have so far shown leaf disease susceptibility ranging from 4.0 to 9.2% while the others are free.

(*h*) During 1959, twelve intra-crosses between the progeny of station selections S. 288, S. 795 and B.A. 21 and collections from Rume and Barbuk, S. 12 Kaffa, Padang, San Ramon, and Philippinean were planted in the field for study of their field performance.

(*i*) *Salient points from field studies on advanced generations of selections and hybrids :* A few salient points on observations on the field performance of advanced generations of selections and hybrids planted from 1952 may be noted.

(i) *S. 795 Progeny :* Among the first generation progeny of S. 795 planted in 1952, one culture has shown a low percentage, 5%, leaf disease susceptible segregates, while the other two cultures have recorded up to 21.6% The yield of these cultures over a period four years has averaged at 5.8 to 6 cwt./acre. This, however, is affected by the yearly programme of bagging for controlled pollination and analysis of fruits at various stages during development.

The second generation progeny of S. 795 planted in 1956 have shown up to 16.7% leaf disease susceptible segregates. The progeny maintain the vigorous growth characteristic of the strain.

(ii) *Intra-crosses of Selections and B.A. Series :*

(1) F_1 of B.A. 21 × B.A. 16 planted in 1952 has recorded low, 9.8%, leaf disease susceptible segregates and its yield has ranged from 0.94 cwt./acre to 5.84 cwt./acre over a period of four years.

(2) F_1 of B.A. 21 × B.A. 9 and B.A. 23 × B.A. 21 planted in 1953 have shown 26.3% and 16.7% leaf disease susceptible segregates. Their preliminary yields have averaged up to 3 cwt./acre. The plants are vigorous and show tendencies of future higher crops.

(3) Crosses between B.A. 2, B.A. 25, B.A. 36 and S. 446 planted in 1954 have shown no indications of leaf disease susceptibility in the field so far. A first crop up to 3.9 cwt./acre was harvested during the year.

Crosses between B.A. 13, B.A. 19, B.A. 22, S. 44 (2 gen.) and Kents show from 1.1% to 12.5% leaf disease susceptible segregates. Their first yield has ranged up to 4.2 cwt./acre.

(4) F_1 of B.A. 22 × B.A. 12 planted in 1955 has so far remained free from leaf disease in the field and has vigorous growth.

(5) The crosses between B.A. 18, S. 178 (1st gen.) and F_1 of S. 26 × Kents planted in 1956 have remained free from leaf disease in the field, while the crosses B.A. 29 × S. 178 (1st gen.), and S. 178 (1st gen.) × S. 795 have recorded up to 3.6% leaf disease susceptible segregates.

(6) It is seen from the above that combinations of parents have been secured that show either full field resistance to leaf disease or a high degree of resistance. The earlier established cross-breds also indicate good or moderate yields. Further observations on leaf disease resistance, yield and quality of the produce will continue.

(iii) Among the cultures planted from 1957 to 1960 are combinations which include (1) Station Selections S. 795, S. 288, S. 333, S. 44 (2nd gen.); (2) S. 12 Kaffa and Rume and Barbuk Sudan showing marked resistance to leaf disease in the field, (3) K.P. 423, a high yielding Lyamungu Kents arabica selection established at Balehonnur, and (4) Philippinean, Padang and San Ramon having good quality beans. Their behaviour in the field so far indicates that leaf disease resistance is dominant and that many of them are vigorous in growth.

3. *Comparative trials of seedling progeny of selections of B.A. series :* The trials laid out during 1956 with seedling progeny of 20 arabica cultures of the B.A. series was continued. These cultures continue to maintain field resistance to leaf disease and vigorous growth.

4. *Comparative trials of clonal progeny from best performers :* (*a*) *B.A. Series I.*—The randomized replicated trial to test the comparative merits of 20 arabica cultures (B.A. 5, 6, 11, 12, 13, 19 to 27, 30 to 32 and 34 to 36) planted in 1951 and 1952 was continued. These cultures maintain field resistance to leaf disease as in the previous years. The average yields of cultures in terms of clean coffee per acre is given in Table B-I. The yield of the cultures is comparatively low during the year. On the mean of six years yields numerically B.A. 12 has led the other cultures closely followed in order by B.A. 11, 19, 13, 36 and 23.

(*b*) *B.A. Series II.*—The randomized replicated trial, to test the comparative merits of 16 arabica cultures (B.A. 1, 4, 7, 8 to 10, 13 to 18, 28, 29, 33 and seedling progeny of B.A. 19) planted during 1952 and 1953 was continued. As in the previous years these cultures maintain field resistance to leaf disease and have vigorous growth. The average yield of the cultures in terms of clean coffee per acre is given in Table B-II. On the mean of four years yields numerically B.A. 18 has led the other cultures closely followed in order by B.A. 28, 16 and 13.

5. *Observational studies on the performance of the progeny of outstanding plants selected from private estates :* (*a*) Fourteen collections out of the 18 retained for observations again showed low and negligible yields as in the previous years. Some of the collections continued to show floral abnormalities like petallody and star flowers. Further observations on these is restricted to a few selected individual plants which have field resistance to leaf disease, vigorous growth and comparatively better yields (at over 4 to 5 cwt./acre) with a view to raise their progeny for field studies.

(*b*) Observations on leaf disease susceptibility on plants established during 1956 from a collection each from Woger estate and Kogilahalla estate (Mysore State) for the last four years have shown that in the former the susceptibility is up to 14% and in the latter up to 52.2%. The resistant plants are showing vigorous growth

(*c*) Fifty plants were established during 1957 from two collections from Kotada estate, Nilgiris, Madras State. Observations during the year showed that up to 50% of the plants in both the collections have leaf disease susceptibility at the station. Their growth is also not very vigorous.

The few seedlings that were brought over from Kotada estate during the latter part of 1958 and planted in the station nursery did not establish. It is proposed to obtain seed material from the parent plants from the next harvest and raise seedlings.

(*d*) Seedlings raised from four marked plants in Seagahalli hybrid plots in Sulegode estate, Saklespur, Mysore State, were planted in the field during 1959. They are under observation.

(*e*) Marking of outstanding plants in private estates was continued. During the year seedlings have been raised in the nursery from collections from Kankanahalla, Koonmakki, Baganeheddal and Cannoncadoo estates in Mysore State.

6. *Interspecific Crosses :* (*a*) Study of interspecific hybrids with particular emphasis on robusta-arabica hybrids, their back crosses, and self-bred progeny was continued. The co-ordinated studies on cytological and morphological characteristics, as well as leaf disease resistance and yield and quality were also continued.

(i) *Robusta* × *Kents arabica hybrids and progeny :* For the third year in succession the BC_1 and BC_2 with Kents arabica have continued to maintain leaf disease resistance in the field. The selected highest yielding plant in BC_2 (at 31 cwt./acre during 1957–58, 12 cwt./acre during 1958–59 and 11.4 cwt./acre during 1959–60) remained free from leaf disease during the year.

For the third year in succession, BC_1 with robusta and the open pollinated progeny from this continued to maintain leaf disease resistance in the field.

The plants in BC_1 and BC_2 with Kents arabica and the open pollinated progeny of BC_1 with robusta retained for observations, responded satisfactorily to 1.77 inches (44.25 mm.) blossom showers during the year.

Three years observations on fruit analysis confirm that the produce contains a high percentage of peaberry and floats, (peaberry ranging from 12.8 to 85.2%, floats ranging from 2 to 23.6%) as a result of which the ratio in outturn of fruit to clean coffee (fruits required to obtain 1 lb. of clean coffee) varies from 5.1 to 11.3. The redeeming feature of these cultures is the low percentage (up to 5%) of false polyembryony, which compares favourably with Kents and Coorgs arabica.

The three years data confirm that the selected plants in BC_1 and BC_2 with Kents arabica whose self-bred progeny was established in the field during 1959 are resistant to leaf disease and continue to give high yields (10.9 cwt./acre, and up to 13.6 cwt./acre respectively). In the progeny of these as well as the progeny of one plant of BC_1 with Kents arabica further back-crossed to Kents arabica, and further progeny from two selected plants in the open pollinated progeny from BC_1 with robusta, leaf disease susceptible segregates are seen so far up to 9%. Wide variation in the population is also noticed.

BC_3 with Kents arabica established during 1954 show up to 22.2% leaf disease susceptible segregates. The resemblance of these susceptible plants to Kents arabica is very close. The leaf disease resistant plants show wide variation. The yield during the year recorded 1.65 cwt./acre and the produce contained 45.9% peaberry.

(ii) *Crosses between Diploid species.*—Crosses between C. excelsa, C. eugenioides and C. canephora (robusta) and C. liberica were effected during 1955 and their progeny established.

C. excelsa × *C. eugenioides.*—Ten out of 60 plants resemble the C. excelsa female parent in all characters indicating that they may be of parthenogenetic origin. The rest of the plants show wide variation. A high percentage (up to 84.6%) sterility of pollen grains as well as defect in the produce is observed.

C. canephora (*robusta*) × *C. eugenioides.*—The two plants in this cross resemble closely the C. canephora parent ; and this indicates that they may have arisen by parthenogenetic development. Crosses between the two parents were effected during 1958–59 blossom season. C. canephora × C. eugenioides failed to set. In the reciprocal 5 seedlings have been raised.

C. canephora (*robusta*) × *C. liberica.*— Twenty-eight plants of this cross were established in the field during 1955. Eighteen plants resemble C. canephora and thus indicate that they may have arisen by parthenogenetic development. The remaining 10 plants show wide variation. These plants show leaf disease resistance in the field, and high sterility. Only one plant yielded a few fruits during the year.

(*b*) *Devamachy hybrids :* (1) Observations over a period of 5 years have shown that the progeny of Devamachy × S. 881 (collection from Rume Sudan) has remained free from leaf disease in the field. The remaining crosses between Devamachy collections and arabica selections and collections show up to 35.5% leaf disease susceptibility except the cross Devamachy × S. 451 Kents arabica which shows up to 80% susceptibility. A first preliminary crop on brown wood was recorded during the year, ranging up to 2.2 cwt./acre.

(2) Four crosses between Devamachy hybrid collections and S. 795 and S. 333 established in 1957 continued to be under observation. While two of the crosses continued to remain free from leaf disease in the field, the other two showed up to 20% susceptible plants.

II. Robusta

1. *Comparative trials of Seedling progeny from best performers :* (*a*) *BR Series* :— The trials laid out during 1956 with the seedling progeny of 12 robusta cultures of the BR series (B.R. 1 to 3, 5, 6, 8 to 12, 14 and 17) was continued. The plants are continuing to grow vigorously.

2. *Comparative trials of clonal progeny from best performers :* (*a*) *BR Series I.*—The randomized replicated trial to test the comparative merits of ten robusta cultures (B.R. 2, 3, 5, 6, 7. 9, 11, 12, 15 and 17) planted in 1951 and 1952 was continued. The average yields of the cultures in terms of clean coffee per acre are given in Table B-III. The yield of the cultures during the year was very low, and 3 cultures (B.R. 2, 6 and 17) failed to crop. On the average of 5 years yields, BR. 6 and B.R. 12 are showing higher yields.

(*b*) *B.R. Series II.*—The randomized replicated trial to test the comparative merits of 10 robusta cultures (BR 1, 4, 6, 8, 10, 13, 14, 16, 17 and seedling progeny of S. 274) planted during 1952 and 1953 was continued. The cultures failed to yield any crop during the year. The average yields of the cultures in terms of clean coffee per acre are given in Table B-IV. BR 10 and BR 14 are leading the others in yield.

It may be mentioned that the robusta harvest has been very low in the station estate in general and in the neighbourhood of the station.

3. *Observational trials on the performance of the progeny of outstanding plants from private estates (Field collections) :* Plants raised from seeds of 40 marked plants in Hope estate, Coorg, Mysore State, established at Balehonnur Station during 1956 are continuing to have vigorous growth.

III. Collection of coffee seed material from countries outside India :

Collections of seeds of coffee species, varieties and selections from countries outside India was continued.

1. *World collections*—1953 *series :* Leaf disease was quite severe on Bourbon amarelo, Bourbon vermelho, Caturra amarelo, Laurina maragogype and Mundo novo and considerable defoliation occurred in spite of protective Bordeaux Mixture applications. The crop on these ranged from 0.96 cwt./acre to 2.53 cwt. per acre during the year. On the average of three years yields, Bourbon amarelo has given 2.7 cwt./acre, Bourbon vermelho 3.6 cwt./acre Mundo novo 2.5 cwt./acre, Caturra amarelo 1.5 cwt./acre and Laurina Maragogype 1.2 cwt./acre.

The progeny of B.A. 1, 12, 16 and 19 planted for comparison show up to 25% leaf disease susceptible plants. Their yield during the year is B.A. 1 = 2.38 cwt. per acre, B.A. 12 = 1.43 cwt. per acre, B.A. 16 = 0.64 cwt. per acre, B.A. 19 = 5.49 cwt. per acre as against B.A. 1 = 6 cwt. per acre, B.A. 12 = 3.3 cwt. per acre, B.A. 16 = 3.8 cwt. per acre, and B.A. 19 = 8.2 cwt. per acre during 1958–59.

2. *World collections*—1954 *series :* Twenty-seven collections of arabica along with Station Selections S. 288 and S. 446 are under observation. A high percentage of plants, 80 to 85% in Tafarikela and S. 12 Kaffa showed isolated spots of leaf disease on a few leaves. In general the plants retained the full crown of leaves and did not suffer in vigour from the low disease incidence. In contrast, the remaining 25 varieties as well as S. 446 suffered defoliation due to leaf disease.

The second crop harvested during the year has recorded Tafarikela, Philippinean, Pache and Padang with 4.4 to 4.8 cwt./acre. The rest of the varieties including KP .423 selection, have ranged from 0.2 cwt. to 2.9 cwt./acre.

Coffee samples from Blue Mountain, Padang, Philippinean, S. 12 Kaffa, Tafarikela and Rume were cup-tasted at London. Blue Mountain, Philippinean and S. 12 Kaffa have been assessed at F.A.Q. to good, and the rest as " falling off ".

3. *World collections*—1955 *series :* Forty-two arabica collections and 6 species are under observation. All the collections show susceptibility to leaf disease. However, 73% plants in Rume Sudan have continued to maintain freedom from leaf disease in the field.

4. *World collections*—1956 *series :* Sixty collections of arabica and 7 species of Coffea are under observation. All the arabica collections and Coffea species show leaf disease susceptibility to varying degrees. However, 88.6% plants in Sudan Barbuk and C. salvatrix continue to maintain freedom from leaf disease.

5. *World collections—1957 series :* Twenty-seven collections of arabica, and C. canephora are under observation. All the collections (including progeny of Geisha observed to be free from leaf disease till last year) have shown susceptibility to the disease.

6. *World collections—1958 series :* C. canephora, C. robusta, C. congensis, progeny of C. arabica × C. liberica, Rume and Barbuk Sudan, BE 5 and 10 are under observation. Except Rume and Barbuk Sudan collections, all the others showed leaf disease in the field.

7. *World collections—1959 series :* Seedlings raised from No. 113 S. 6, Cioccie, No. 113_2 S. 6. Cioccie, No. 110_5 S. 4 Agaro, No. 110_2 S. 4 Agaro, No. 128 Dilla and Alghe, No. 681_1 U.L. Dalecho, and No. 134 S. 12 Kaffa have been planted in the field. The seed material for these was sent by Dr. Branquinho d' Oliveira and they are mentioned as being resistant to Races I, II and IV (W. W. Mayne's) except 110_5 S. 4 Agaro.

8. *World collections—1960 series :* The following seed materials were received during the year under report, and seedlings have been raised.

(i) C. horsfieldiana : Director-General, Institute National Pour L' Etude Agronomique Do congo Belge.

(ii) Var. Murta, Cera, Laurina, Erecta, Yellow Bourbon, Maragogype, Xanthocarpa — Director, Instituto Agronomico Do Estado De Sao Paulo, Campinas, Brazil.

9. Collections of coffee material received since 1953 from institutions outside India consist of 135 varieties, forms and selections of arabica, 4 of liberica, 10 of robusta, 2 of excelsa, racemosa, salvatrix, Kapakata, Kawisari B and D, congensis, stenophylla, eugenioides, and horsfieldiana. These include practically all the commercially important varieties among established coffees in the several countries of the world, as well as, arabica coffee material that is mentioned as being resistant to 8 out of 10 races established by Dr. Branquinho d' Oliveira, and reported high yielding arabica selections in other countries. Promising material from the collections has been made use of in the coffee breeding work at Balehonnur Station and the progeny are under observation as mentioned in an earlier section.

B. Extension work with selections

1. *Seed plots at Balehonnur Station :* The seed blocks established at Balehonnur station with S. 795, S. 947, S. 532 and S. 846, during 1954 and 1955 were continued to be maintained. The plants are continuing to grow vigorously. The crop recorded from the 1954 seed plot during the year was S. 795 = 3.2 cwt. per acre, S. 947 = 3.2 cwt. per acre, S. 846 = 2 cwt. per acre, S. 532 = 1.2 cwt. per acre, S. 645 = 1.2 cwt. per acre, as against S. 795 = 4.6 cwt. per acre, S. 947 = 3.3 cwt. per acre, S. 846 = 1.6 cwt. per acre, S. 532 = 0.5 cwt. per acre, and S. 645 = 0.16 cwt. per acre during 1958–59.

A first crop of $2\frac{1}{2}$ cwt. per acre was recorded from the S. 795 seed plot (1955 planting).

2. *Regional seed plots :* The zonal seed plots of S. 795 established from 1954–55 for obtaining seed for meeting the increasing demands for seed coffee were continued. Rogueing and selection of plants in the plots were done. Seed collections and preparation were also done under the supervision of the Research Department. During the year seed coffee was obtained from the seed plots in the following estates :—

Mysore State.—

(i) Bagneheddal Estate, Chickmagalur P.O.

(ii) Urvinkhan Estate, Javali P.O.

(iii) Kibbetta Estate, Somwarpet P.O.

(iv) Balagunda Estate, Somwarpet P.O.

(v) Madapur ' A ' Estate, Madapur P.O.

(vi) Haradur Estate, Suntikoppa P.O.

(vii) Pannia Estate, Suntikoppa P.O.

Madras State.—

(viii) Glenvans Estate, Ouchterlony Valley Estates (1938) Ltd., New Hope P.O. Nilgiris.

3. *Seed preparation at Balehonnur station :* 1278 lb. seeds of arabica selections, 477 lb. of robusta selections and 80 lb. excelsa were prepared at Balehonnur Station and delivered to the Senior Liaison Officer (Development) for distribution.

4. *Seed supply to countries outside India :* 3½ lb. seeds of arabica selections, ½ lb. of robusta selections, and sample seeds of C. bengalensis were supplied to (1) Director of Agriculture, Kuching, Sarawak, and (2) Laboratoire De Ecologie Vegetales Heverele Lonvaird, Belgium, and (3) Head of the Division of Botany, I.A.R.I., New Delhi, for supplying to Yugoslavia. 4 oz. sample seeds of each of S. 881 1/6, and S. 881 4/8, S. 882 1/2 and S. 882 2/1 (Rume and Barbuk collections) and rooted cuttings of S. 353 4/5 were supplied to Dr. Branquinho d' Oliveira, Portugal, through the good offices of Tropical Crop Specialist, FAO, Rome, for his studies on reaction to races of coffee rust fungus.

5. *Performance of station selections in trial plots in countries outside India :* (*a*) Encouraging first reports have been received on the performance of station selections supplied to countries outside India since 1952–53.

(*b*) Dr. Branquinho d' Oliveira working on the races reactions of the coffee rust fungus (Hemileia vastatrix B and Br) has established S. 288–23 type reaction as Class G (resistant to races I to VI and X, and susceptible to races VII to IX), and 353–4/5 type reaction as class H (resistant to races I to VI and IX and X, and susceptible to races VII and VIII).

(*c*) Field resistance to leaf disease has been reported from Philippines, Madagascar, Tanganyika and Kenya. S. 288 is said to be most vigorous growing in Philippines and to lead all the other resistant selections in the trial plots. The variability among the population is commented upon by Tanganyika, whereas it is said to be one of the best strains in vigour and uniformity in the trial plot at Luna in Philippines.

(*d*) In the small-scale trial plantings at sea level, 1 mile from the Atlantic Coast at Miami, Florida, U.S.A., B.A. 2, 3, 8, 14, 27 and 36 exhibited no evidence of foliar or wood

damage following a very cold spell in which the temperature dropped to between 31° and 33°F on three nights ; B.A. 21 on the other hand suffered from this and defoliated.

(*e*) First yields reported from Tanganyika are S. 288 = 4.85 cwt. per acre, S. 645 = 3.31 cwt. per acre, and S. 953 = 1.33 cwt. per acre in the unshaded trial plots, whereas, in the shaded trial plots the yields are lower. Philippines reports up to 1.84 lb. clean coffee per plant in the trial plot. The quality assessment of selections during 1959 in Tanganyika is F.A.Q. and above.

(*f*) Philippines confirms our earlier observations that plants with bronze coloured young leaves produce dark red cherries when ripe and other plants with green young leaves produce yellowish red cherries when ripe.

C. Vegetative propagation

1. *Grafting :* (*a*) The standardized technique for conversion of robusta or moribund or hybrid stocks without stumping them at first, by wedge grafting green tender suckers arising on the main stem at 12 to 15 inches from ground level is being successfully adopted for large scale grafting in estates. During the year under report, 4 estates in Koppa, Saklespur and South Coorg areas effected grafting on sizeable blocks of robusta and hybrid coffee. The estate in the neighbourhood of the station which adopted the technique on a 15 acre block of robusta during 1958–59 is satisfied with the progress of the grafts and the successful conversion of the robusta to arabica crown by this method.

(*b*) Regional demonstrations were held by five Liaison Officers in selected estates in their zones in Mysore and Kerala States as during last year. These enabled a large number of both big and small acreage growers witnessing the demonstration.

(*c*) Trials were done using local materials like plantain fibre, agave fibre and alkathene strips for binding the graft union. Use of alkathene has resulted in 79% ' take ' as against 48% and 62% take with plantain fibre and agave fibres respectively. These trials have been repeated.

2. *Rooting of Sucker Cuttings :* Trials with proprietary products Seradix L. 15 and L. 30, Indole butyric acid and cows urine extract for inducing rooting of single-noded-green-leafy-sucker cuttings are in progress for the past four years. A consistent rooting of 70% and over has been recorded with Seradix L. 15. The other treatments have given rooting up to 60% as against control (untreated) up to 45.6%.

Owing to the non-availability of Seradix L. 15 and L. 30, large-scale treating of cuttings could not be attempted.

D. Multiple *vs.* single stem system of growing coffee

1. Four sets of observational trials on the multiple *vs.* single stem system of growing coffee laid out in 1950 and 1951 with a view to gain local knowledge of the relative merits of the two systems were continued. The yield data are given in Table B-V to B–VIII.

2. Nine years records from three sets of trials with arabica coffee continue to indicate that in two trials single stem plots have out-yielded multiple stem plots by 29.04% and 6.3%

while in the third trial, the increased yield registered by multiple stem plots over the single stem is up to 4.2%. However these differences are not significant.

3. The trials with robusta show that on the aggregate of 8 years' yields the single stem plots have continued to record increase over the multiple stem plots—an increase of 53%.

E. Laboratory studies

Cytological studies were continued as in the previous years to define the chromosomal make up of species, varieties, selections, and inter-specific hybrids of coffee.

1. *Studies in Kents arabica :* During the year, the meiotic behaviour of the haploid plant isolated during 1957–58, was pursued. The studies confirm that the meiosis is highly irregular and univalents are scattered throughout the spindle. As a result unequal distribution of chromosomes occurs. Microcytes and unreduced microspores are seen.

Out of 7 seedlings raised from a few peaberries from open pollination, 2 show tetraploidy ($2n = 44$) and normal Kent arabica characters. The remaining five show retarded growth. They are under observation.

2. *Tetraploidy in robusta induced by colchicine treatment :* The two robusta plants in which doubling of chromosomes was induced by treatment with colchicine as reported in the earlier reports, continued to be under study. Chromosome analysis of one plant shows quadrivalent formation in up to 70% pollen mother cells. Up to 45% normal pollen is seen to occur. However, the fruit set for the last three years is practically negligible and the few fruits show malformed endosperm and empty locules.

3. *Crosses between Diploid species :* F_1 plants of C. excelsa × C. eugenioides, C. canephora × C. eugenioides and C. canephora × C. liberica have shown $2n = 22$. In one plant of C. liberica × C. eugenioides, however, one branch shows cells with $2n = 44$ chromosomes, interspread among other cells with the diploid number.

Pollen analysis shows microcytes and unreduced gametes up to 84.6% and 46.4% respectively in F_1 of C. excelsa × C. eugenioides and C. canephora × C. liberica. The pollen grains range in size from 7.8μ to 89.7μ. The high sterility of the crop in these as well as the meiotic abnormalities indicate an unbalanced constitution. Further studies are in progress.

4. *Triage studies in coffee :* The studies initiated under this project from 1958 were continued.

(i) (*a*) Developing fruits were analysed in Kents and Coorgs arabica, S. 26, S. 288, S. 795 and their progeny. Clean coffee was also analysed from marked individual plants in these.

The occurrence of false polyembryony (initiation of more than one ovule per locule), is seen to vary from season to season *e.g.*, S. 795 1st gen. recorded 19.2%, 6.7%, and 11.6% during 1958, 1959 and 1960 respectively. Similar variations are seen in other varieties also. Due to false polyembryony, bits, hollowed and other abnormal beans of triage are produced.

Analysis over three seasons confirms that comparatively S. 288, its progeny, and S. 795 show higher percentage of false polyembryony than Kents and Coorgs arabica. On the average S. 288 has recorded 20.9%, its progeny ranges from 30.8% [S. 619 (2nd gen.)] to 42.9% [S. 947 (3rd gen.)], S. 795—12.5%, Kents 3.1%, and Coorgs 3.1%. In the progeny (1st gen.) of selected plants from S. 795, it is noticed to be comparatively low being 4.9% to 8.9%.

The second generation progeny of S. 795 which has just come to cropping stage are under study. From preliminary observations in these, initiation of more than one endosperm unit in a single ovule is observed in addition to false polyembryony.

Abortion of ovules at various stages of development both in normal and polyembryonic locules are observed. It is seen to occur up to 25.6% in S. 288 progeny, 17.2% in S. 795, and up to 12.2% in Kents and Coorgs arabica. This abortion tends to reduce somewhat the production of triage, and to increase the percentage of peaberry. Empty locules are also produced by this abortion.

S. 947 (3rd gen. of S. 288) which recorded 7.4% ovule abnormalities during 1958–59 recorded an increase to 24.0% during 1959–60, and a reduction in false polyembryony from 48.2% during 1958–59 to 24.0% during 1959–60.

(*b*) True polyembryony (occurrence of more than one embryo in the same ovule) also is seen to vary from season to season. Its occurrence is of the same order in S. 288, S. 795, Kents and Coorgs arabica and ranges up to 0.24%.

(*c*) Three bean fruits (Trilocular), black beans, brown beans and subnormal beans occur up to the same extent in Kents and Coorgs arabica, and in the selections studied. It occurred up to 1.6% during 1958–59 and up to 1.95% during 1959–60.

(*d*) Malformed beans may also arise due to causes other than those mentioned above which are still not well understood. This category appears to form the major percentage of triage in Kents and Coorgs arabica and a very minor one in the case of selections.

(ii) *Study of the extent of hybridity in S.* 795, *S.* 288 *and Kents arabica :* In this study pollen analysis commenced during 1958–59 was continued. The occurrence of sterile pollen in S. 26, S. 288 and its progeny was observed to vary from 10% to 89.9% during 1958–59 and 13% to 50% during 1959–60. In S. 795, it varied from 20% to 54% during 1958–59 and 11.4% to 43.4% during 1959–60, and, in the progeny of S. 795 it varied from 5% to 89.9% during 1958–59 and 6% to 95.8% during 1959–60. Seasonal variation is thus seen in this case also.

As during 1958–59 this year also a majority of plants in (*a*) S. 26, S. 288 and its progeny produced 20 to 40% sterile grains; (*b*) S. 795 produced 30 to 40% sterile grains during 1958–59 and 20 to 40% during 1959–60 ; and, (*c*) in the first generation progeny of S. 795 a large majority produced 10 to 30% sterile grains.

Chromosome counts from individual plants in S. 288, its progeny and S. 795 and its progeny were carried out. This indicates that all the plants contain $2n = 44$. Only two plants, 1 in S. 288 progeny and one in S. 795 1st gen., show $2n = 66$.

(iii) *Study of positional effect on fruit development leading on to triage :* The effect of (*a*) maturity of cropping wood, and (*b*) thinning of crop/pruning on the development of fruit and production of triage studied for two years on Kents and Coorgs arabica, and S. 26 have so far not given any favourable response in the reduction of triage. The studies have been extended to S. 795 progeny during the year.

(iv) *Study of nutritional effect on fruit development leading on to triage :* Analysis of clean coffee samples from Kents arabica of the manurial experimental series of the chemistry division was done. Two years data indicate that in plots receiving NK application, the triage percentage is higher than the other treatments. The plots receiving N which gave 4% triage less than NP and NPK treatments during 1958–59, however, registered slightly higher, 1.9%, triage over the NP and NPK plots.

Treatments	Percentage triage during 1958–59	Percentage triage during 1959–60	Mean
Control (No treatment)	18.1	24.2	21.2
N. (at 60 lb./acre)	14.2	19.0	16.6
NP (at 60 lb. 30 lb./acre) ...	18.8	17.1	18.0
NK (at 60 lb. 40 lb./acre) ...	27.1	34.1	30.6
NPK (at 60 lb. 30 lb., 40 lb./acre)	18.2	17.1	17.7

(v) *Study of climatic factors in inducing triage production :* Data is under study. As yet no conclusive information is available.

F. Miscellaneous crops

1. *Shade trees for coffee :* (*a*) 4 lb. seeds of Maesopsis eminii were supplied to Fair Glen estate, Yercaud, in the North-East monsoon zone in Salem district, Madras State.

(*b*) Sample seeds of Alnus nepalensis was supplied to Kodeneri estate, Nilgiris and to Liaison officers at Coonoor, Yercaud and Coimbatore.

2. Of the introduced shade trees Cordia abyssinica, Albizzia maranguensis, A. coriaria A. sumatrana, are growing vigorously. Cordia abyssinica is seen to be damaged by leaf eating caterpillar as well as leaf rollers.

3. During the year, seed of Alnus nepalensis was received from West Bengal. Though the seeds germinated well the seedlings did not grow and died even at the seed leaf stage.

Seeds of Albizzia procera, A. odoratissima and Derris robusta were received from Assam and seedlings have been raised.

G. Experiments at the Coffee Research Sub-Station, Chethalli

The varietal trial laid out during 1949 to test the Station Selections S. 795, S. 288, S. 645, and S. 446 as described in the earlier annual reports was continued. Ninth crop from this trial was recorded during the year. The data are given in Table B-IX. On the aggregate of nine years yields, S. 795 leads the others closely followed in order by S. 645, S. 288 and S. 446.

R. L. NARASIMHASWAMY,
Botanist.

TABLE B-I.

Comparative Trials of Clonal Progeny—B.A. Series I

Locality : Balchonnur, Mysore State.
Area of Experimental Block : 59.5 cents.
Variety : Arabica Hybrids.
Layout : Randomized block.
Treatments : 20 Cultures of the B.A. Series.
Replications : 8.
Guard row : One on either side.
Spacing : 6 feet × 6 feet.
Shade : Natural Shade.
Plot : 3 plants in a row.

Mean Yield of Replications—Calculated Yield of Clean Coffee in cwt. per acre (1,200 plants)

Cultures	Yield in cwt. during						Average for six years
	1954–55	1955–56	1956–57	1957–58	1958–59	1959–60	
B.A. 5 ...	0.60	1.49	0.95	7.34	4.36	1.27	2.67
B.A. 6 ...	1.05	1.68	1.07	5.02	6.51	2.78	3.02
B.A. 11 ...	2.25	2.84	3.95	11.01	5.29	4.41	4.96
B.A. 12 ...	5.22	3.35	2.34	10.92	5.88	4.59	5.38
B.A. 13 ...	2.79	1.19	3.65	9.14	7.04	2.94	4.46
B.A. 19 ...	5.76	2.21	2.29	8.24	5.81	2.50	4.47
B.A. 20 ...	3.15	1.51	3.12	6.57	6.39	3.02	3.96
B.A. 21 ...	0.96	1.08	1.59	9.99	5.66	0.53	3.30
B.A. 22 ...	2.43	2.39	1.65	7.50	4.54	0.42	3.16
B.A. 23 ...	3.45	2.26	3.05	9.73	5.67	0.53	4.12
B.A. 24 ...	1.14	0.31	2.48	9.01	3.52	1.33	2.97
B.A. 25 ...	1.44	1.11	1.47	10.55	4.32	0.47	3.23
B.A. 26 ...	0.75	1.41	1.79	4.41	2.37	0.45	1.86
B.A. 27 ...	1.05	1.51	1.18	6.57	3.46	0.85	2.44
B.A. 30 ...	0.48	1.26	1.23	6.92	3.47	0.54	2.32
B.A. 31 ...	2.85	3.94	0.98	6.42	2.21	0.05	2.74
B.A. 32 ...	1.08	1.60	0.49	3.68	2.74	0.79	1.73
B.A. 34 ...	1.41	1.68	0.31	2.64	1.93	0.43	1.40
B.A. 35 ...	2.61	2.88	3.07	6.82	3.34	3.99	3.79
B.A. 36 ...	2.04	2.18	1.67	10.74	5.24	3.78	4.28

TABLE B-II.

Comparative Trials of Clonal Progeny—B.A. Series II

Locality : Balehonnur, Mysore State.

Variety : Arabica Hybrids.

Replications : 6.

Area of experimental block : 45 cents.

Spacing : 6′ × 6′.

Guard row : One on either side.

Shade : Natural Shade.

Layout : Randomized block.

Plot : 3 plants in a row.

Treatment : 15 Arabica cultures of B.A. Series and Seedling progeny of 645.1/6 (B.A. 19).

Mean Yield of Replications—Calculated Yield of Clean Coffee in cwt. per acre (1,200 plants)

Cultures	Yield in cwt. during				Average for 4 years	Cultures	Yield in cwt. during				Average for 4 years
	1956–57	1957–58	1958–59	1959–60			1956–57	1957–58	1958–59	1959–60	
B.A. 1 ...	1.90	3.49	5.08	2.69	3.29	B.A. 15	0.10	0.85	1.14	0.22	0.58
B.A. 4 ...	1.12	3.46	3.90	1.06	2.39	B.A. 16	4.49	5.21	2.59	2.31	3.65
B.A. 7 ...	0.20	4.13	1.93	0.52	1.70	B.A. 17	0.15	2.31	2.35	1.67	1.62
B.A. 8 ...	0.22	0.14	1.15	0.11	0.41	B.A. 18	5.49	5.30	4.94	2.32	4.40
B.A. 9 ...	1.46	4.22	4.54	3.14	3.34	B.A. 19 (645.1/6)	2.75	2.21	6.48	2.01	3.36
B.A. 10	1.07	2.91	1.83	0.95	1.69	B.A. 28	6.15	5.44	3.13	2.83	4.39
B.A. 13	1.90	4.62	3.30	4.33	3.54	B.A. 29	0.63	3.39	2.89	2.29	2.30
B.A. 14	0.20	2.38	2.89	0.09	1.39	B.A. 33	2.78	3.14	5.23	1.00	3.04

TABLE B-III

Comparative trials of clonal progeny—B.R. Series I

Locality : Balehonnur (Mysore State).

Variety : Robusta.

Treatments : 10 cultures of the B.R. series.

Replications : 9.

Spacing : 9′ × 9′.

Layout : Randomized block.

Plot : 3 plants in a row.

Guard row : One on either side.

Shade : Natural shade.

Area of experimental block : 96 cents.

Mean Yield of replications—Calculated yield of clean coffee in cwt. per acre (538 plants)

Cultures	Yield during					
	1955–56	1956–57	1957–58	1958–59	1959–60	Average for 5 years
B.R. 2 ...	0.4	0.81	3.87	3.01	...	1.62
B.R. 3 ...	1.7	0.98	6.73	3.42	0.08	2.52
B.R. 5 ...	1.1	1.04	5.78	5.20	0.09	2.64
B.R. 6 ...	2.9	1.89	8.24	5.24	...	3.65
B.R. 7 ...	1.4	2.28	4.75	4.21	0.87	2.70
B.R. 9 ...	1.8	0.43	8.80	3.35	0.07	2.89
B.R. 11 ...	1.5	1.10	4.96	1.55	0.08	1.84
B.R. 12 ...	4.2	0.93	8.78	2.83	0.19	3.39
B.R. 15 ...	0.3	0.82	3.61	4.45	1.92	2.22
B.R. 17 ...	1.4	0.81	1.14	4.36	...	1.54

TABLE B-IV

Comparative trials of clonal progeny—B.R. Series II

Locality : Balehonnur (Mysore State)

Area of experimental block : 93 cents.

Variety : Robusta.

Layout : Randomized block.

Treatments : 9 cultures of the B.R. series and seedling progeny of S. 274 (Robusta).

Plot : 3 plants in a row.

Replications : 8.

Guard row : One on either side.

Spacing : 9′ × 9′.

Shade : Natural shade.

Treatments : The cultures of the B.R. series are :—B.R. 1, B R. 4, B.R. 6, B.R. 8, B.R. 10, B.R. 13, B.R. 14, B.R. 16, B.R. 17, and S. 274 seedlings.

Mean Yield of Replications—Calculated Yield of Clean Coffee in cwt. per acre (538 plants)

Cultures	Yield during				
	1956–57	1957–58	1958–59	1959–60	Average for 4 years
B.R. 1 ...	0.44	0.35	0.15	...	0.24
B.R. 4 ...	0.97	1.59	1.80	...	1.09
B.R. 6 ...	0.55	2.53	2.00	...	1.27
B.R. 8 ...	0.66	1.68	2.75	...	1.27
B.R. 10 ...	1.23	2.53	4.84	...	2.15
B.R. 13 ...	1.03	1.95	1.38	...	1.09
B.R. 14 ...	1.99	2.57	5.26	...	2.46
B.R. 16 ...	0.58	2.19	2.28	...	1.26
B.R. 17 ...	0.52	1.04	1.62	...	0.80
S. 274 Robusta Seedling ...	0.92	2.07	1.12	...	1.03

TABLE B-V

Yield Data of Plots on Multiple Stem *vs.* Single Stem System of Growing Coffee

EXPERIMENT : I

Locality :Balehonnur (Mysore State).
Variety-S. 288, S. 333 S, 433, S. 434 and Kents. (Each variety having 12 rows of 16 plants in each row).
Treatments : A. Single stem ; B. Multiple Stem.
Layout : A.B., B.A. Pattern.

Age of Plants : 13 years from Seed.
Period of Conversion : May 1950.
Shade : Natural shade.
Spacing : 6′ × 6′.
Area of Experimental Block : 95.2 cents.

Year	Description of crop	Yield of Ripe Cherry (actual) in lb. and calculated yield of Clean Coffee in cwt./acre (1,200 plants).													
		A. Single Stem							B. Multiple Stem						
		S. 288	S. 333	Kents	S. 433	S. 434	Kents	Mean	S. 288	S. 333	Kents	S. 433	S. 434	Kents	Mean
1952	Ripe Cherry ...	63	83	19	7	22	22	36	21	8	7	4	5	3	8
	Clean Coffee ...	1.17	1.52	0.35	0.13	0.42	0.41	0.66	0.38	0.15	0.13	0.07	0.09	0.06	0.15
1953	Ripe Cherry ...	55	98	32	103	116	10	69	177	83	28	99	135	8	88
	Clean Coffee ...	1.02	1.82	0.60	1.92	2.16	0.18	1.28	3.28	1.53	0.52	1.83	2.52	0.15	1.64
1954	Ripe Cherry ...	243	421	226	227	416	374	318	463	338	370	452	643	160	404
	Clean Coffee ...	4.52	7.83	4.20	4.22	7.74	6.96	5.91	8.6	6.28	6.88	8.41	11.96	2.98	7.52
1955	Ripe Cherry ...	180	128	115	49	62	75	101	144	125	113	73	56	84	99
	Clean Coffee ...	3.34	2.38	2.13	0.91	1.15	1.39	1.88	2.68	2.32	2.12	1.36	1.04	1.56	1.85
1956	Ripe Cherry ...	643	597	404	328	539	248	460	880	622	267	225	367	117	413
	Clean Coffee ...	11.96	11.14	7.51	6.10	10.03	4.61	8.56	16.37	12.46	4.97	4.19	6.82	2.18	7.83
1957	Ripe Cherry ...	206	119	45	74	58	40	90	147	118	53	92	135	70	103
	Clean Coffee ...	3.83	2.21	0.84	1.38	1.08	0.74	1.68	2.73	2.19	0.99	1.41	2.52	1.30	1.86
1958	Ripe Cherry ...	904	982	253	348	653	362	584	445	310	140	196	224	227	257
	Clean Coffee ...	16.81	18.27	4.71	6.47	12.15	6.73	10.86	8.28	5.77	2.60	3.65	4.17	4.22	4.78
1959	Ripe Cherry ...	328	257	126	182	136	89	186	287	233	47	129	168	192	176
	Clean Coffee ...	6.10	4.77	2.34	3.39	2.53	1.65	3.46	4.48	4.33	0.87	2.40	3.13	3.57	3.13
1960	Ripe Cherry ...	529	439	354	190	634	463	434.83	265	184	318	51	364	141	221
	Clean Coffee ...	9.78	8.17	6.36	3.53	11.79	8.61	8.04	4.92	3.42	5.92	0.95	6.77	2.62	4.10
Mean	Ripe Cherry ...	350.11	347.11	174.89	167.56	292.89	187.00	253.26	314.44	224.56	149.22	146.78	233.00	111.36	196.56
	Clean Coffee ...	6.50	6.46	3.23	3.12	5.45	3.48	4.71	5.74	4.27	2.78	2.70	4.34	2.07	3.65

NOTE : (1) 6 lb. of ripe cherry has been taken to yield 1 lb. of clean coffee.
(2) On the aggregate of 9 years' yields the multiple stem plots have registered a decrease of 29.04% over the single stem plots.

TABLE B-VI

EXPERIMENT : II

Yield Data of Plots on Multiple Stem *vs.* Single Stem System of Growing Coffee

Locality : Balehonnur (Mysore State).
Variety : Arabica Hybrids.
Treatments : 4 during the year of conversion.
Replications : 4.
Shade : Natural shade.

Layout : Randomized blocks.
Plot : 4 × 16 = 64 plants.
Spacing : 6′ × 6′.
Age of plants : 26 years from seed.
Period of conversion : March 1951.

Area of the Experimental Block : 105.8 cents.

Treatments :

A. Single Stem.

B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

C. Extended centring up to one foot from the centre was done during the year of conversion, March 1951, to facilitate free growth of three suckers for forming the multiple stems. After crop harvest during March 1952, the main stem was stumped to a height of 2 feet from ground level, retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

D. Except the two top primary branches, all the other branches were cut down during the year of conversion (March 1951) to facilitate the free growth of three suckers. After crop harvest during March 1952, the topmost primary branch was retained to act as a lung branch and the three suckers form the multiple stems.

Mean Yield of Ripe Cherry (actual) in lb. and calculated yield of Clean Coffee in cwt. per acre (1,200 *plants*).

Treatments	Ripe Cherry (Actual)									Clean Coffee (Calculated)									Mean of 9 years
	1952* lb.	1953 lb.	1954 lb.	1955 lb.	1956 lb.	1957 lb.	1958 lb.	1959 lb.	1960 lb.	1952* cwt.	1953 cwt.	1954 cwt.	1955 cwt.	1956 cwt.	1957 cwt.	1958 cwt.	1959 cwt.	1960 cwt.	
A.	38.63	47.14	208.46	100.44	190.83	393.70	256.9	76.75	70.30	1.08	1.31	5.81	2.80	5.32	10.98	7.17	2.14	1.96	4.29
B.	22.11	12.24	262.16	92.31	192.90	388.90	222.6	93.63	53.60	0.62	0.34	7.31	2.58	5.40	10.85	6.21	2.61	1.50	4.16
C.	24.62	26.11	272.46	110.06	251.00	388.00	267.70	33.19	74.20	0.68	0.73	7.66	3.07	7.00	10.60	7.47	0.93	2.07	4.47
D.	38.38	34.73	246.84	99.38	225.49	371.00	257.25	50.00	68.18	1.07	0.97	6.77	2.77	6.29	10.35	7.18	1.40	1.90	4.30

* Crop of the year of conversion

NOTE : (1) 6 lb. of ripe cherry has been taken to yield 1 lb. of Clean Coffee.

(2) On the aggregate of 9 years' yields, treatment *B* has registered a decrease of 3.03% over that of the single stem (Treatment *A*), while treatments *C* and *D* have registered an increase of 4.2% and 0.23% respectively over the single stem.

TABLE B-VII

EXPERIMENT : III

Yield Data of Plots on Multiple Stem *vs.* Single Stem System of Growing Coffee

Locality : Balehonnur (Mysore State).

Variety : Arabica Hybrids.

Treatments : 2 : *A.* Single Stem. *B.* Multiple Stem.

Replications : 21.

Shade : Natural shade.

Layout : A.B., B.A. Pattern.

Plot : 16 plants in a row.

Spacing : 6′ × 6′.

Age of plants : 15 years from seed.

Period of conversion : March 1951.

Area of Experimental block : 52 cents.

Mean Yield of Ripe Cherry (actual) in lb. and calculated Clean Coffee in cwt. per acre (1,200 plants).

Treatments	Ripe Cherry (Actual)										Clean Coffee (Calculated.)									
	1952*	1953	1954	1955	1956	1957	1958	1959	1960	Mean	1952*	1953	1954	1955	1956	1957	1958	1959	1960	Mean
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.		cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	cwt.	
A.	5.78	19.43	24.72	18.99	11.94	39.29	15.00	40.71	13.69	21.06	0.64	2.17	2.76	2.12	1.32	4.38	1.67	4.54	1.53	2.35
B.	3.90	8.03	21.49	15.20	24.82	42.27	18.24	32.81	11.35	19.79	0.44	0.89	2.40	1.69	2.80	4.72	2.04	3.66	1.27	2.21

* Crop of the year of conversion.

NOTE : (1) 6 lb. of Ripe Cherry has been taken to yield 1 lb. of clean coffee.

(2) On the aggregate of 9 years' yield, the single stem plots have registered an increase of 6.3% over that of the multiple stem plots.

TABLE B-VIII

Yield data of plots on Multiple Stem *vs.* Single Stem of Growing Coffee

Locality : Balehonnur (Mysore State).
Variety : Robusta.
Treatments : 2. A : Single Stem.
B : Multiple Stem.
Spacing : 9′ × 9′.
Area of experimental block : 65.50 cents.
Layout : Opposite quadrants on a rectangular block are on each of two treatments.
Shade : Natural shade.
Replications : 2.
Age of plants : 13 years from seed.

Period of conversion : September 1951.

Mean yield of ripe cherry per plot (actual) in lb. and calculated yield of clean coffee in cwt. per acre (538 plants)

Year	Description of the crop	Ripe Cherry in lb. and Clean Coffee in cwt./acre	
		A. Single Stem	B. Multiple Stem
1953	Ripe Cherry	121.06	52.69
	Clean Coffee	1.33	0.58
1954	Ripe Cherry	110.30	153.63
	Clean Coffee	1.20	1.61
1955	Ripe Cherry	138.00	105.34
	Clean Coffee	1.50	1.15
1956	Ripe Cherry	312.00	213.5
	Clean Coffee	3.41	2.35
1957	Ripe Cherry	394.00	136.00
	Clean Coffee	4.30	1.49
1958	Ripe Cherry	229.63	168.00
	Clean Coffee	2.51	1.83
1959	Ripe Cherry	484.50	367.00
	Clean Coffee	5.29	4.01
1960	Ripe Cherry	69.50	21.00
	Clean Coffee	0.76	0.23
Mean	Ripe Cherry	232.37	152.15
	Clean Coffee	2.54	1.66

NOTE.—(1) 5 lb. of ripe cherry has been taken to yield 1 lb. of Clean Coffee.

(2) New suckers are developing on the plants for the second cycle.

(3) On the aggregate of 8 years yields the single stem plots have registered an increase of 53% over the multiple stem plots.

TABLE B-IX

Arabica Varietal Trial at the Coffee Research Sub-Station, Chethalli P.O., Coorg, Mysore State

Locality : Chethalli, Coorg (Mysore State). *Size of plots :* 12 × 8 = 96 plants.

Treatments : 4 : A : S. 446, B : S. 795, C : S. 645 *Spacing :* 6½′ × 6½′.
D : S. 288 *Planted :* 1949.

Shade : Natural shade. *Area of experimental block :* 1.49 acres.

Layout : Latin Square.

Yield per acre of Ripe Cherry in lb. and Calculated Yield of Clean Coffee Cwt./acre.

Year	Description of crop	Yield: Clean (A)	Ripe Coffee (B)	Cherry in Cwt. (C)	In lb. per acre (D)	Mean	Sem%	Significant or not	Critical difference	Conclusions
		S. 446	S. 795	S. 645	S. 288					
1952	Ripe Cherry ...	875	255	193	133	364	23.48	Yes	191	A B C D
	Clean Coffee ...	1.30	0.38	0.29	0.20	0.54	...	...	0.43	...
1953	Ripe Cherry ...	3,746	1,897	1,366	808	1,954	16.22	Yes	1,095	A B C D
	Clean Coffee ...	5.57	2.82	2.03	1.20	2.91	...	...	1.63	...
1954	Ripe Cherry ...	1,541	3,402	2,478	1,498	2,230	14.18	Yes	1,096	B C A D
	Clean Coffee ...	2.29	5.06	3.69	2.23	3.32	...	...	1.63	...
1955	Ripe Cherry ...	6,939	9,043	4,865	4,404	6,313	...	Yes	...	B A C D
	Clean Coffee ...	8.84	13.46	7.24	6.55	9.02	...	...	...	...
1956	Ripe Cherry ...	1,997	8,551	5,821	4,259	51.57	...	Yes	...	B C D A
	Clean Coffee ...	3.00	12.70	8.60	6.30	7.65	...	...	...	...
1957	Ripe Cherry ...	9,208	10,548	9,422	8,765	9,486	...	No	...	B C A D
	Clean Coffee ...	13.70	15.70	14.02	13.04	14.12	...	...	...	...
1958	Ripe Cherry ...	3,000	15,838	12,584	8,872	10,074	9.21	Yes	2,375	B C D A
	Clean Coffee ...	4.58	23.55	18.75	13.22	15.03	...	...	3.39	...
1959	Ripe Cherry ...	3,991	4,200	4,638	3,974	4,201	...	No	...	C B A D
	Clean Coffee ...	6,00	6.20	6.90	5.90	6.20	...	...	...	.....
1960	Ripe Cherry ...	4,496	5,172	3,323	2,328	3,830	...	No	...	B A C D
	Clean Coffee ...	6.50	7.40	4.90	3.40	5.60	...	...	...	...

III. CHEMISTRY

Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on the growth and health factors formed the main items of work of this division. The division also attended to the routine examination of soils and plant materials for advisory work and undertook visits to problem areas for investigation and advice on soil and crop husbandry.

FIELD EXPERIMENTS

A. Manurial Experiments

(i) Studies on the essential requirements of plant foods, N.P.K. for coffee in relation to improvement in yield. (New manurial Series I)

Twenty crops have been picked from this experiment which was started in 1937. As reported in earlier reports, the plant population remains at 20 plants per sub-plot. The yield data and the results obtained are presented in Table C-1.

It is seen from the data, that treatments are *not significant* in case of ripe cherry. The trend in the case of cherry is NPK, NK, NP and Control. The treatments are *significant* in case of clean coffee. It is noticed from the data that treatments D (NPK), C (NK), and B (NP) are all *on par*, but treatments D (NPK) and C (NK) are *significantly superior* to A (Nitrogen alone) and E (Control—no manure). Treatments B (NP), A (N only) and E (Control) are all *on par*. The yield recorded this year is the lowest since the first crop was picked in this experiment.

Statistical analysis of the average yield of ripe cherry and clean coffee over 20 years and 12 years respectively have been carried out. The data are presented in Table C-1. The data reveals that the treatments are *significant* both in case of ripe cherry and clean coffee. Treatments B (NP) and D (NPK) are *significantly superior* to A (N only) and E (Control) in case of ripe cherry, whereas treatment B (NP) in case of clean coffee is *significantly superior* to rest of the treatments. Treatments B (NP) and D (NPK) ; D (NPK) and C (NK) ; C (NK) and A (N only) are all *on par* but these are *superior* to E (Control). The trends observed are in accordance with the observations made in the previous years.

(ii) Studies on the manurial requirement of coffee in relation to improvement in yield

(*a*) *N.P.K. trial with varying levels of N, P, and K (Fundamental experiments in pH Cisterns) :* Only twenty-one out of thirty-six plants yielded any crop, hence the yield data could not be statistically analysed. One plant was uprooted on account of root-rot and the other fourteen plants did not record any crop. This is the lowest crop recorded since this experiment was started. The plants suffered right from the beginning, and the indifferent and patchy blossoms aided by adverse seasonal conditions led to a very poor crop.

(*b*) *N.P.K. trials with varying levels of Nitrogen with constant levels of P and K. (17 acre manurial experiments—1951 clearing) :* This experiment as described in previous reports was continued. For the second successive year, patchy and indifferent blossoms adversely affected the crop. The yield record of the experiment is presented in Table C-2. Statistical analysis of the yield data reveals that the treatments are *not significant*. However the following trends are noticed. Treatment C (100 : 30 : 40) has recorded the highest yield followed by D (60 ; 30 ;

40), E (40 : 30 : 40), A (Control-no manure) and B (80 : 30 : 40). The average of yields over four-year period, revealed that the treatments are *not significant*. The trends noticed are treatment C (100 : 30 : 40), B (80 : 30 : 40), E (40 : 30 : 40), D (60 : 30 : 40) and A (Control-no manure).

(*c*) *N.P.K. trials with constant levels of N.P.K. but varying sources of Nitrogen :* This experiment as laid out in 1953 was continued. The data is presented in Table C-3. It is seen from the data that treatments are *not significant*. A patchy blossom occurred and resulted in a poor crop. However the trends are E [$(NH_4)_2SO_4$] followed by A (Chilean nitrate), D (Urea), C (Calcium Ammonium Nitrate) and B (Control). In the statistical analysis of the average yield of cherry over two years, it is seen that the treatments are *not significant*. Treatment E [$(NH_4)_2SO_4$] has recorded a high yield followed by treatments D (Urea), C (Calcium Ammonium Nitrate), B (Control) and A (Chilean Nitrate).

(*d*) *N.P.K. trials with varying levels of P and K and constant levels of Nitrogen* (17 acre *manurial experiments*–1954 *series*) *:* This experiment laid out in 1954 was continued. The data is presented in Table C-4. It is seen from the data that treatments are *not significant* Treatment D (80 : 30 : 40) has recorded a high crop followed by treatments A (N only), E (80 : 30 : 60), C (80 : 45 : 40), F (Control-no manure) and B (80 : 45 : 60). This is the first crop recorded for statistical purposes and the previous crop formed the basic data.

(*e*) *N.P.K. trials with varying levels and combinations* (*Arabica manurial experiment at the Coffee Research Sub-station, Chethalli*) *:* The experiment laid out in 1952 was continued. The yield record is presented in Table C-5. Statistical analysis of the yield data reveals the following points—

(1) None of the factors is *significant*.

(2) Increase in yield is noticed with the increase in the application of Phosphate and Potash with adequate N.

(*f*) *Test scale trial at Coffee Research Sub-station, Chethalli :* This trial as described in the previous reports was continued. The yield data from the experimental plots are furnished below :—

Treatments	Yield of ripe cherry in pounds calculated to the acre		Mean
	Block I N applied in 2 equal doses P and K in 2 equal doses	*Block II* N applied in 3 equal doses P and K in 2 equal doses	
N_1 (40 lb. N to the acre) ...	2329	1603	1966
N_2 (60 lb. N to the acre)	908	955	932
N_3 (80 lb. N to the acre)	1497	726	1112
N_4 (100 lb. N to the acre)	1422	1210	1316
N_2P (60 lb. N —30 lb. P_2O_5)—(average of two plots)	1584	1562	1573
N_2PK (60 lb. N—30 lb. P_2O_5—40 lb. K_2O) (average of two plots)	1604	1257	1430

It is seen from the data presented above that application of two split doses of Nitrogen, Phosphate and Potash has recorded high yields this season, whereas in all previous observations, Nitrogen applied in three doses along with Phosphate and Potash in two doses has recorded high yields.

2. Field trials to find out the maximum Economic dose of Nitrogen and the role of Phosphate and Potash in Nitrogen utilisation

The trial, started in May 1956, was continued. The yield record of the harvest is presented in Table C-6. Statistical analysis of the yield data reveals that major treatments are *not significant* whereas sub-treatments are *significant*. Amongst sub-treatments, treatment 1 (NPK) is *significantly superior* to the rest of the treatments. Treatments 2 (NPK+Basal dressing), 3 (N+Basal dressing) and 4 (Nitrogen only) are all *on par*. The trends observed in the case of major treatments are as follows :—

Treatment B (800 lb. N) has recorded a high yield followed by treatments F (100 lb. N.), D (control), A (50 lb. N), E (400 lb. N) and C ((200 lb. N). Last year the order was F (100 lb. N), B (800 lb. N), C (200 lb. N), D (control), E (400 lb. N) and A (50 lb. N). The data is varying from year to year and does not permit conclusions as yet.

3. Effect of different sources of Nitrogen on the growth and yield of mature yielding coffee

This experiment, started in April 1956 in Shegode estate near Coffee Research Station, was continued. The yield record of the experiment is presented in Table C-7. Statistical analysis of the yield data showed that the treatments are *not significant*. However the following trends are noticed. Treatment D (Urea) has recorded a high yield followed by treatments C (Am_2SO_4), B (Calcium Ammonium Nitrate), A (Control-no manure), F (Ammonium Sulphate Nitrate) and E (Chilean Nitrate). In the analysis of average yield over three years, the treatments are *not significant*, and the trends noticed are as follows :

Treatment D (Urea) has recorded a high yield followed by C (Am_2SO_4), A (Control), F (Ammonium Sulphate Nitrate), E (Chilean Nitrate) and B (Calcium Ammonium Nitrate). It is interesting to observe that the same trends were noticed in last year's data with an interchange in the position of treatments E and B.

4. Field manurial trials in private estates : on Arabica coffee

The trial, started in 1954 on ten different estates situated in different soil climatic zones of Southern India, was continued only on seven estates (3 were discontinued). This trial has completed six years of observation. Yield record of the 1958–59 and 1959–60 are presented in Table *C-8A*. Statistical *analyses* of the yield of different estates reveal that both main and sub-treatments are *not significant*. The only exception to this is Togarihankal estate where the main treatments are *significant*. On further examination of the data, the following points become evident. Main treatments B (60 lb. N) and D (100 lb. N) are *on par* but treatment B is *significantly superior* to treatments C (80 lb. N) and A (40 lb. N) Treatments D, C and A are all *on par*.

On a critical assessment of the data of all the estates it is seen that the main treatment A (40 lb. N) has recorded high yields in five estates out of seven under experimentation. In the remaining two estates, treatment B (60 lb. N) has recorded high yields. The results with regard to sub-treatments are varying to draw any conclusions. Average yields from these experiments

expressed as percentage of Nitrogen (mean of N_1 and N_2) are presented in Table C-8B. The following points are noticed in the data :—

(1) Treatments having Phosphorus (NP and NPK), have recorded increased yields in six out of eight cases when compared with Nitrogen alone.

(2) At a basic level of 30 lb. P_2O_5, increased yields have been recorded with Nitrogen levels at 60, 80 and 100 lb. N to the acre. But along with 30 lb. Phosphate and 40 lb. Potash to the acre, there is a reduction in yield at 60 lb. and 100 lb. Nitrogen levels.

(3) Numerically highest yield was recorded at 100 lb. Nitrogen level with 30 lb. P_2O_5 to the acre.

Composite analysis of the yield data for 5 years were carried out in each of the seven estates under experimentation. It is seen from the analysis that main and sub-treatments are *not significant* with the exception of Togarihankal estate. Main treatments are *significant* in Togarihankal estate. Among the main treatments, treatment D (100 lb. N) has recorded the highest yield followed by the treatments B (60 lb. N) and A (40 lb. N), with treatment C (80 lb. N) recording the lowest. Treatment D is *significantly superior* to treatments A and C but not to B, whereas treatment B is *superior* only to C.

In all the estates seasons are highly significant indicating vast differences in yields between seasons.

In most of the cases replications and the interaction due to seasons and replications are *significant*. This indicates that soil heterogenity in the experiment and the variations that occur from season to season in the factor mentioned above, influence yields more than the treatments.

The interactions due to seasons and main treatments, and seasons and sub-treatments are *significant* in two and three cases respectively out of seven estates. These indicate the great variations in the pattern of response to both main and sub-treatments from season to season.

However the following trends are evident from an examination of the data for 5 years in 7 estates.

(1) Main treatment D (100 lb. N) has recorded high yields in eleven cases out of 35, followed by treatment A (40 lb. N) in 10 cases, treatment C (80 lb. N) in nine cases and treatment B (60 lb. N) in 5 cases each out of 35 cases.

(2) Sub-treatment NP has recorded high yields in 12 out of 35, followed by NPK in 9 cases, N_2 in 8 and N_1 in 6 cases each out of 35 cases.

A composite analysis of the average yields for 5 years from all the 7 estates was also carried out. The data indicate that both main and sub-treatments are *not significant*. Further examination of the data shows that main treatment D (100 lb. N) has recorded the highest yield followed by A (40 lb. N), B (60 lb. N) and C (80 lb. N), in the order mentioned. Among sub-treatments, treatment NP has recorded the highest yield followed by NPK and N_1 with N_2 recording the lowest.

Effect due to estates (zones) is *highly significant* indicating the effect of variations in climatic and other ecological conditions existing in different zones. Interactions due to zones and replications, and zones and main treatments are also highly significant. These indicate the variations in the soil heterogenity and the pattern of response to main treatments in the different zones.

The trials have been concluded after the 1959–60 harvest.

5. Manurial experiments on Robusta coffee

(*a*) *N.P.K. trials with varying levels and combinations at Coffee Research Sub-Station, Chethalli :* This trial, started in 1954, was continued. The yield record of the harvest is presented in the Table C-9. This year's data was statistically analysed, as this forms the first full data, last year's data being the basic one.

The following points are noticed in the data :—

(1) Main effects due to N, P and K are *not significant.*

(2) Minor effect due to interaction P and K is *significant.*

(3) Application of Phosphate at 45 lb. per acre have given high yields.

(4) Increase in yield is noticed with the increase in Nitrogen application.

(*b*) *Field manurial trials on Robusta coffee.*—The trials, started in 1955 in Wynaad and Saklespur, were continued. The yield record of the harvest of 1959–60 is presented in Table C-10A. The yield data have been statistically analysed and it is seen from it, that both main and sub-treatments are *not significant.* Further examination of the data reveals that main treatment C (80 lb. N) has recorded high yields in three estates out of five. Increased yields have also been observed in case of sub-treatment NPK in three estates out of five. This is in accordance with the observations made in the previous years.

The yield data from the treatments NP and NPK at different levels of Nitrogen as percentage mean of N_1 and N_2 have been presented in Table C-10B. The following points are brought out from an examination of the data.

(1) At a basic level of 30 lb. P_2O_5 and 40 lb. K_2O to the acre numerically highest yields were recorded at the Nitrogen level of 60 lb. in three out of five estates.

(2) Treatments having P and K at 30 lb. and 40 lb. respectively have recorded increased yields over Nitrogen alone in three out of five cases at 40 lb. N level, four out of five cases at 60 lb. N, 80 lb. N and at 100 lb. Nitrogen levels.

(3) At all levels of Nitrogen, increased yields were noticed in all cases getting an NPK treatment.

(*c*) *Modified field trials on Robusta coffee :* (1) *Series I.*—These field trials started in Wynaad, Malabar, Coorg and Mysore in 1956, were continued. The yield data from the experiments is presented in Table C-11.

Statistical analysis of the yield data of these trials has revealed that the treatments are *not significant* in all the estates except in Banakal estate where the treatments are *significant,*

Treatments A(40 : 30 : 40) and F (40 : 60 : 80) are *on par* and are *significantly superior* to treatments, C (60 : 45 : 60) and B (60 : 30 : 40). Treatments A, F, E and D are all *on par*, similarly treatments E, D and C and treatments D, C and B are all *on par*.

It is particularly interesting to observe from the yield data that, treatment B (60 : 30 : 40) has recorded high yields in three estates out of seven this year. It was treatment A (40 : 30 : 40) which recorded high yields last year.

(2) *Series II.*—These trials, started in Mysore and Wynaad Malabar in 1956, were continued. The yield data is presented in Table C-12. Statistical analysis of the yield data of these experiments, show that the treatments are *significant* in Panchura, and Maniangode estates and *not significant* in others. Treatments A (60 lb. N only), D (PK : 45–60) E (NPK : 60 - 45 - 60), C (NK) and B (N P) in Panchura estate are all *on par* and they are *superior* to treatment F (no manure-control). In Maniangode estate all treatments are *superior* to F (control). Treatments B (NP), A (60 lb. N only), E (NPK) and D (PK) are all *on par*. Treatments A, E, D and C are also *on par*. In general, it is noticed from the data that treatment B (NP) has recorded high yields in three estates out of five.

6. Field trials on the effect of minor elements on the growth and yield of coffee—(Experiment with CHELATES)

This experiment, started in 1957 July, was continued. The details of the treatments were furnished in the Eleventh Annual Report. No visual differences in growth are observed.

7. Studies to find out the maximum economic dose of Nitrogen and the role of Phosphates and Potash in Nitrogen utilisation with and without basal dressing for young coffee—(Experiment in 'O' Block).

The details of the layout and the treatments were furnished last year. The first set of treatments were imposed in June 1959. The plants being young, the blossom was allowed only on the brown wood.

EXPERIMENTS ON THE RESPONSE TO MANURING OF COFFEE SEEDLINGS IN THE NURSERY

(*a*) *N - P - K trials with varying levels and combination.*—This experiment described in detail in the Tenth Annual Report for the year 1956–57 was continued. The first crop was picked last year and this year's crop forms the first full crop. Plants receiving the treatment $N_2P_2K_2$ (40 : 30 : 40) have recorded more crop than rest of the treated plants.

Severe Nitrogen deficiency in plants was noticed in all the N_0 (No Nitrogen) pots. This resulted in heavy defoliation. The plants recovered very slightly after the onset of monsoon.

(*b*) *Trials on the effect of the application of minor elements and CHELATES on the growth of young coffee—(Pot Culture)* : The details of the treatments were furnished last year. The growth measurements recorded showed that treatment A (Es - Min - El) had the maximum number of primaries, secondaries and leaves. It was closely followed by treatment C (Na Fe - iron).

CULTURAL EXPERIMENT

Studies on the growth and yield of coffee in relation to shade requirement—Hedge-row system of planting.—This experiment, started in 1953, was continued. The coffee in the open

recorded 5.8 cwts. of clean coffee per acre as against 4.4 cwts. of clean coffee per acre under shade. Last year coffee under shade recorded more crop than coffee in the open.

Observational trials in private estates

Studies on the response to spray and soil applications of trace elements for coffee plants, suffering from deficiency of minor elements.—This trial was laid out at Neranki estate, Hirebyle area in December 1959. The details of the trial are presented below :

Eighty plants suspected of minor element deficiency were selected all over the estate, and two branches were tagged in each plant. Ten plants selected at random were taken for each treatment. The plants on either side served as border plants.

The following treatments are to be imposed thrice a year, viz., December 1959, April 1960 and September 1960.

(1) Treatment A : Nitrogen magnesia (soil application : At 5.6 gms. per plant per application.

(2) Treatment B : Tracel for Coffee—At 4 lb. in 100 glns. of water as spray.

(3) Treatment C : F.T.E.—Soil application—At 2 gms. per plant.

(4) Treatment D : Solubor—At 1 lb. in 40 gallons of water as spray.

(5) Treatment E : Nu-iron—At 3 lb. in 100 gallons of water as spray.

(6) Treatment F : Cu-Zn-Mn-Fe—At 4 lb. in 100 gallons of water as spray.

(7) Treatment G : Metaquest-Soil application—At 4 gms. per plant.

(8) Treatment H : Control—Plain water—Plain water spray.

Observations to be recorded.—Monthly observations on the tagged branches are to be recorded as follows :—

(1) Whether there is any improvement in affected leaves.

(2) Whether new flush is normal.

(3) Whether there is any general improvement in affected bush.

The first set of treatments were imposed in December 1959. Observations recorded after the first application of treatment showed that treatment F (Cu-Zn-Mn-Fe) responded to the treatment. There was a distinct change in the colour of the leaves and the new flush was normal. This continued even after the application of the second set of treatments in April 1960. The plants receiving this treatment have completely recovered. After the application of the second set of treatments improvement was noticed in case of plants receiving the treatment B (Tracel for coffee). The improvement has been gradual in this case and the plants have recovered and are presenting a healthy look. There has been practically no improvement in case of the other treated plants.

B. Laboratory

Work in the Laboratory consisted mainly of analysis of plant and soil samples collected by the division from the experimental plots and problem areas :

1. Studies of Foliar Feeding on Plant Nutrients :

To confirm the observations made in the trials conducted earlier in 1956–57, the plants were sprayed again with N, P and K singly or in combination in March 1960. The details of the experiment are given in the Tenth Annual Report for the year 1956–57. Leaf samples were collected before and at shorter intervals after the application of treatments, *i.e.*, at 2, 4, 8, 24 and 48 hours, with a view to study the minimum time required and the rate of absorption of nutrients. The analyses are under progress.

2. Analysis of seedlings collected from Nursery Manurial Trials—Series II

This study started in March 1957 has been described in detail in the Tenth Annual Report for the year 1956–57. The study was concluded in July 1958 and results pertaining to observations on growth measurements were discussed in detail in the Eleventh Annual Report for the year 1957–58. Analysis of the seedlings and soil samples collected, was completed during the year under report, and the analytical data are presented in Tables C-13, C-14A and C-14B.

Total Nitrogen : It is interesting to note that the values for Nitrogen in leaves of seedlings collected for the first set (August 1957) were lower than the Nitrogen values in stalks in all the treatments. There was a sharp fall in Nitrogen values in stalks of the second set (October 1957) in all the treatments, while fall in Nitrogen values in leaves was very little. As the plants grew older the values for Nitrogen in leaves increased. A critical examination of the data also reveals that there are fluctuations in Nitrogen values in plants, and this follows a regular pattern of alternate increase and decrease. There is a tendency observed that, where there is an increase in values for Nitrogen in leaves ,there is a decrease in the corresponding set of roots and *vice versa*. There is an increase in Nitrogen values from the third set (December 1957) onwards with the increase in the dosage of fertilizers. A clear increase in Nitrogen values in leaves is noticed between the first set (August 1957) and the last (sixth set collected in July 1958) set of seedlings collected. This increase is marked in the case of plants receiving higher dosages of fertilizers. The same trends are noticed in the case of stalks and roots but there is a reduction in Nitrogen values from the first and the last sets of seedlings collected.

Proximate analysis of the seedlings reveal that the total Nitrogen content in seedlings collected from control plots is higher than those treated with higher dosages of fertilizers. This decreases gradually with the increase in dosage of fertilizers.

Total Phosphoric Acid : P_2O_5 values in the first set (August 1957) of leaves and roots were fairly uniform, but varied in the case of stalks. Leaves of N_o treated plots had low P_2O_5 values whilst in other treated plots of the first set the values were fairly uniform. It steadily increased up to thrid set (December 1957), after which it decreased gradually till the fifth set (April 1958), and again showed a slight increase in the sixth and last sets. The exceptions to this increase are treatments N_3, $N_3P_3K_3$, N_4 and $N_4P_4K_4$, in whose case a decrease was noticed. P_2O_5 values showed a clear increase between the first set (August 1957) and the last set (July 1958) in N_o, $N_oP_oK_o$ and N_1 plots whilst with rest of the treatments this did not hold good. A reduction in P_2O_5 values was noticed in N_4 treated plots.

P_2O_5 values in stalks of the first set were not uniform ; the highest and lowest values were found in $N_1P_1K_1$ and $N_3P_3K_3$ treated plots respectively. It decreased slightly in the second set (October 1957) and showed an increase in third set (December 1957), after which it steadily decreased up to the fifth set (April 1958). It again increased slightly in the sixth set. A general decrease in P_2O_5 values, between the first and last sets was clearly noticed in all the treated plots.

Root samples recorded a sharp rise in P_2O_5 values in the second set, after having had fairly uniform values in the first set. N_1 and $N_1P_1K_1$ treated plots did not show appreciable change in the fourth set, after which they showed a gradual decrease in fifth and sixth sets. In general, P_2O_5 values decreased with the increase in fertilizer application. A clear increase in P_2O_5 values between the first set and the last set was noticed only in the case of N_o treated plots, but there was a decrease in the case of other treated plots.

Proximate analysis of the seedlings showed that P_2O_5 content is high in seedlings from control plots (N_o and $N_oP_oK_o$) and N_1 plots. It decreased with the increase in dosages of fertilizers.

Total Potassium : The Potassium values in the first set of leaves (August 1957) were fairly high in all the treated plots. Leaves of N_3 and N_o treated plots showed a decrease in the second set (October 1957), while an increase was noticed in rest of the treated plots. Values for Potassium in leaves of N_2 and N_1 treated plots showed practically no increase or decrease. Leaves of N_2 treated plots showed a gradual increase from thrid set (December 1957) onwards up to the fifth set (April 1958) after which it showed a steep fall in the sixth set. A gradual decrease in Potassium values was noticed in leaves of N_1 treated plots from third set (December 1957) and it continued up to the sixth and final sets. There was a slight increase in values for Potassium in leaves of third set in N_o, $N_oP_oK_o$, $N_5P_5K_5$, and $N_2P_2K_2$ treated plots and fell off in the fifth and the sixth sets. The values for Potassium in leaves of the $N_5P_5K_5$, $N_4P_4K_4$, $N_3P_3K_3$ and $N_1P_1K_1$ treated plots slightly increased in the fourth set and thereafter, it had a steep fall in the sixth set. The exception to this are $N_3P_3K_3$ treated plots which increased in the fifth set also and decreased in the sixth set. A clear increase in Potassium values were noticed in $N_4P_4K_4$ treated plots between the first and the last sets but not in other treated plots.

Potassium values in stalks of the first set (August 1957) were not uniform. The lowest value was found in case of $N_3P_3K_3$ treated plots. A slight decrease in Potassium values, occurred in stalks of the second set (October 1957) in N_3, $N_oP_oK_o$ and N_4 plots whilst there was no change in N_2 and N_1 treated plots. (A slight increase was noticed in general in most of the treated plots in the fourth set, *i.e.*, February 1957). With the exception of $N_2P_2K_2$ treated plots there was a steep fall in values for Potassium in the fourth set and it fell further in the fifth and sixth sets. There was an increase in Potassium values in $N_2P_2K_2$ treated plots in the fifth set and it had a steep fall in the sixth set. In general Potassium value decreased between the first and the last set in all the treated plots.

Root samples in general, had fairly good values for Potassium in the first set. There was a general decrease in the second set (October 1957) and this continued up to the fifth set. There was slight increase in values for Potassium in the sixth set when compared to the fifth set, but in general, there was a decrease in Potassium values between the first and the last sets.

NPK treated plots in general, had more of Potassium than plots treated with Nitrogen alone. Fluctuations in values for Potassium were noticed and an alternate increase and decrease pattern was noticed. Proximate analysis of the seedlings reveals that the Potassium content was high in control plots than in plots treated with fertilizers. A decrease in Potassium content was seen with the increase in fertilizer application.

Soil samples collected after the conclusion of the trial were analysed in the laboratory. The analytical data is presented in the Table C-14A.

Nitrogen, Potassium and Calcium were high in all the plots in general, but the values for Phosphate are low. Nitrogen was high in plots receiving Nitrogen alone amongst higher doses of fertilizers. Plots treated with lower doses of fertilizers upto N_5 had higher Nitrogen content in NPK treated plots than in plots treated with Nitrogen alone. Potash and Calcium were high in NPK plots in all the treatments and it was still higher in NPK plots treated with higher doses of fertilizers. Phosphate was low in all the plots.

The following points are revealed by the proximate analyses of the seedlings :

(1) Nitrogen was high in seedlings collected from control plots while it was not so in seedlings receiving fertilizer applications.

(2) Phosphate was high in seedlings from control and N_1 plots whereas it was not so in others.

(3) Potassium was high in seedlings from control plots whereas it was not so in others.

It may be concluded from the above that heavier applications of fertilizers in the nursery had a depressing effect on growth. Nitrogen, Phosphorous and Potassium decreased with the increase in fertilizer application. Provided that the soil on which the plants are grown is rich, further applications of fertilizers may not be of much advantage.

3. Analysis of Arabica coffee plants and its different parts

To study the plant nutrients present in an Arabica coffee plant and in different parts of it, 3 plants of different age groups were uprooted. The plants were uprooted in such a manner as not to damage even the root hairs. The gross weight of the plants recorded in case of the 3 year old plant, was 7 lb., 30.2 lb. in 15–20 year old plant and 30.5 lb., in that of an old coffee plant over 40 years.

Analysis was carried out separately, of the root hairs, root, bark, stem, primaries, secondaries and tertiaries, young leaves, old leaves, third pair of leaves, a representative composite sample of leaves and lastly berries. The analytical data are presented in Table C-16.

Nitrogen

1. *Berries :* Berries of the 15–20 year old coffee plant had higher Nitrogen content than in the 3 year old and 40 year old coffee in the order mentioned.

2. *Leaves :* Values for Nitrogen were high in young leaves of the 40 year old coffee followed by 15–20 year old and 3 year old coffees. It was high in old leaves of 15–20 year old,

40 year old and 3 year old coffee in the order mentioned. Third pair of leaves in 15–20 year old and 40 year old coffees had more Nitrogen than in the 3 year old coffee whilst in a composite sample consisting of old, young, and third pair of leaves, it is higher in the 3 year old coffee than in 40 year old and 15–20 year old coffees.

3. *Branches—Secondaries and Tertiaries :* Nitrogen content was low in secondaries and tertiaries of a 40 year old coffee but it was high in the 3 year old and 15–20 year old coffee in the order mentioned. Secondaries and tertiaries had more Nitrogen in it than a 40 year old coffee.

4. *Primaries :* Nitrogen in primaries of the 15–20 year old coffee was higher than that of a 40 year old coffee. In general primaries have a comparatively less Nitrogen content than those of secondaries and tertiaries.

5. *Stem :* Nitrogen content in stem was high in the 40 year old coffee followed by 3 year old and comparatively much less in a 15–20 year old coffee. Stem has a lower content of Nitrogen than those of primaries.

6. *Bark :* Nitrogen was high in bark of 15–20 year old coffee than that of a 40 year old coffee. It was higher than those of secondaries and tertiaries, primaries and stem.

7. *Root :* Root samples of a 3 year old and 15–20 year old coffee had a higher Nitrogen content than that of a 40 year old coffee plant. Root samples in general had more Nitrogen than those of primaries and stem samples but they had lesser Nitrogen content when compared with bark and secondaries and tertiaries.

8. *Root-hairs :* 15–20 year old coffee had more Nitrogen in root-hairs than that of a 40 year old coffee plant. It was higher in Nitrogen content than that of secondaries and tertiaries, primaries, stem and root-samples but it was slightly less than that of barks.

Nitrogen content was higher in leaves, berries, bark and root-hairs in the order mentioned when compared with the other parts of the plant. Primaries and stem had lowest values for Nitrogen in the order mentioned, but it was higher in secondaries and tertiaries. There does not appear to be any appreciable difference in Nitrogen content with difference in age.

Organic Carbon : Organic carbon was high in berries, roots, primaries and stem in the order mentioned. Leaves and secondaries and tertiaries contained comparatively lesser Organic Carbon content than roots, primaries and stem. There are no differences in Organic Carbon content between young leaves, old leaves, bark and secondaries and tertiaries. Comparatively higher values were found in older coffees than in young coffee.

Carbon/Nitrogen : Carbon/Nitrogen values are higher in stems, primaries, roots, secondaries and tertiaries and root–hairs. It was very much lower in leaves, berries and bark than in stems, primaries, roots, secondaries and tertiaries and root–hairs.

Total Phosphoric Acid

1. *Berries :* Berries of a 40 year old coffee had more P_2O_5 in it than in 15–20 year old and 3 year old coffees.

2. *Leaves :* Young leaves in general had a higher P_2O_5 content than old leaves. Leaves of the 3 year old plant had a higher P_2O_5 content than those of 15–20 year old and 40 year old coffees in the order mentioned. It was high in third pair of leaves and in a composite sample of leaves in a 3 year old coffee. It was low in 15–20 year old coffee in both third pair of leaves and in composite sample of leaves while it was fairly well supplied in case of a 40 year old coffee.

3. *Branches—Secondaries and Tertiaries :* The P_2O_5 content was high in a 3 year old coffee in secondaries and tertiaries while it was low in 15–20 year old and 40 year old coffee in the order mentioned.

4. *Primaries :* P_2O_5 content was low both in 15–20 year old and 40 year old coffees.

5. *Stem :* The stem of a 3 year old coffee showed higher P_2O_5 values than of a 40 year old and 15–20 year old coffees and it was greater than that of primaries.

6. *Bark :* P_2O_5 values in bark were fairly high. Comparatively 15–20 year old coffee had a higher P_2O_5 content than in an old coffee of 40 years.

7. *Roots :* Roots samples of a 3 year old coffee had more P_2O_5 in it than that of a 15–20 year old and 40 year old coffees. It was comparatively low when compared with secondaries and tertiaries and was high when compared with primaries and stems.

8. *Root-hairs :* Root-hairs of a 40 year old coffee had higher P_2O_5 content than that of a 15–20 year old coffees. It was comparatively higher than that of root samples.

In general, leaves and berries contained higher quantities of P_2O_5 than in other parts of the plant. Though it is also high in bark and root-hairs, it is not as high as that of berries and leaves. Primaries and stem have lower values than in secondaries and tertiaries and root samples. It may perhaps be concluded that an young coffee plant stores up more P_2O_5 in all parts of the plant than old coffees. Berries of old coffee of 40 years are an exception to this as they had more P_2O_5 in them than in others.

Potassium

1. *Berries :* Potassium was present in higher quantities in berries of a 3 year old coffee than that of a 40 year old and 15–20 year old coffees.

2. *Leaves :* Potassium was present in higher quantities in young leaves than in old leaves. Young and old leaves of a 40 year old plant had more Potassium in it than in 15–20 year old and 3 year old coffees in the order mentioned. It was also high in composite leaf sample and in third pair of leaves of a 40 year old plant. Potassium content in young leaves, old leaves, third pair of leaves and in composite sample of leaves was low in all the cases of a 3 year old coffee while it was fairly well supplied in older coffees.

3. *Branches—Secondaries and Tertiaries :* Potassium content was higher in secondaries and tertiaries of a 3 year old coffee than in a 15 year old and 40 year old coffees in the order mentioned.

4. *Primaries :* Potassium was low both in 15–20 year old and 40 year old coffees in the order mentioned. It is low when compared to the Potassium content in secondaries and tertiaries.

5. *Stem :* Three year old coffee had more Potassium in its stem than in 15–20 year old and 40 year old coffees. It is low when compared to secondaries and tertiaries.

6. *Bark :* Potassium was low in the bark of a 40 year old coffee whereas it was high in the bark of 15–20 year old plant.

7. *Roots :* Root samples of a 3 year old coffee had a higher Potassium content than those of 15–20 year old and 40 year old coffees in the order mentioned.

8. *Root-hairs :* Potassium content was higher in a 40 year old plant than in a 15–20 year old plant.

Potassium was high in leaves and berries in general than in other parts of the plant. It was also high in bark and root-hairs but not so high as that of leaves and berries. Primaries and stem recorded lower values for Potassium whereas it was high in secondaries and tertiaries but not so high as that of root-hairs and bark. Potassium was low in leaves of a 3 year old coffee whereas it was fairly well supplied in older coffees.

Calcium

1. *Berries :* Berries of a 40 year old coffee had more of Calcium in it than in a 3 year old and 15–20 year old coffees.

2. *Leaves :* Young leaves had a little less Calcium content than old leaves. It was higher in young leaves of the 15–20 year old coffee than in a 3 year old and 40 year old coffees. Old leaves had in general more of Calcium in them than in young leaves. It was high in leaves of the 3 year old followed by the 40 year old and 15–20 year old coffees. Calcium content was high in third pair of leaves of a 15–20 year old coffee followed by 40 year old and 3 year old coffees. Forty year old coffee had more Calcium in the composite samples of leaves than in 15–20 year old and 3 year old coffees in the order mentioned.

3. *Branches—Secondaries and Tertiaries :* Calcium content was more in secondaries and tertiaries of 40 year old coffee than in those of 15–20 year old and 3 year old coffees.

4. *Primaries :* Primaries of a 40 year old coffee had a higher Calcium content in them than in a 15–20 year old coffee.

5. *Stem :* Stem of the 40 year old coffee had a high Calcium content in it followed by 15–20 year old and 3 year old coffees. It was very low in the stem of 3 year old coffee. In general, values for Calcium were lower than in secondaries and tertiaries and leaves.

6. *Bark :* Calcium content was high in the bark of a 15–20 year old coffee than in a 40 year old coffee. It is very much higher in the bark of 15–20 year old coffee than in leaves, secondaries and tertiaries.

7. *Roots :* Roots of a 3 year old coffee had very much higher Calcium content in them than in a 40 year old and 15–20 year old coffees. It is low in roots when compared with primaries, stem, secondaries and tertiaries.

8. *Root-hairs :* Calcium content was high in root-hairs of a 15–20 year old coffee than in a 40 year old coffee. It is very low in this part of the plant when compared with other parts of the plant.

In general, Calcium was high in leaves, bark and berries. Bark of 15–20 year old coffee had the highest Calcium content in it when compared with different parts of it and with different parts of 3 year old and 40 year old coffees. Root-hairs had the least quantity of Calcium. It was generally high in almost all the parts of a 40 year old coffee.

Considering the whole plants, Nitrogen was well supplied in 15–20 year old coffee followed by 3 year old and 40 year old coffees in the order mentioned. Organic carbon content was a bit lower in 15–20 year old coffee than in 3 year old and 40 year old coffees. Phosphoric acid was well supplied in a 3 year old coffee followed by 40 year old and 15–20 year old coffees. Potassium and Calcium were fairly high in a 40 year old coffee followed by 3 year old and 15–20 year old coffees. Potassium was low in both young and old leaves of a 3 year old coffee whereas it was fairly well supplied in leaves of older coffees.

4. Studies to correlate yield with Leaf Nitrogen content at the time of blossom

This study was started in April 1959 to correlate yield with Leaf Nitrogen at the time of blossom. Nine blocks in the Coffee Research Station, Balehonnur having different crop yields were categorised as high, medium and low for this purpose. Three sets of leaf samples were collected, the first before blossom (March), the second a week after the blossom (April) and the last one before the harvest (December). Samples were analysed for total Nitrogen, Organic Carbon, total Phosphoric acid, total Potassium and total Ash. The analytical data along with the yield data of different blocks are presented in Table C-15. The trends observed in the analytical data are presented below :

(1) Leaf samples collected before blossom had a fairly good Nitrogen content, total Phosphoric acid and total Potassium. This may be due to the pre-blossom application of fertilizers. There was a fall in Potassium and Phosphoric acid values in leaf samples collected after the blossom whilst there was an increase in Nitrogen values.

(2) There was a fall in Nitrogen values in the third set of leaf samples collected at the time of harvest. An increase in Potassium values was seen when compared with samples collected after blossom. No differences in Phosphoric acid values were noticeable.

(3) Samples collected both on the cropping and non-cropping wood before the harvest showed that total Nitrogen and Potassium were high on the non-cropping wood,

but not so in the case of cropping wood. Differences in Phosphoric acid values were not noticeable.

It is seen from the data that quite a lot of variation exists between the blocks, hence it does not permit valid conclusions to be drawn. The study is being repeated.

5. Soil samples from New Manurial Series

Soil samples were collected from the New Manurial Series to study whether there are any deleterious effects on soil by continuous application of fertilizers. Soils were examined chemically and mechanically. The analytical data is presented in Table C-17.

It is seen from the data that the soils are all well supplied with optimum levels of plant nutrients. The values for Phosphoric acid in NP and NPK plots are higher than those of N, NK and control. The mechanical analysis of the soil reveals that the soils have more of fine fraction than coarse fraction and may be classed as a clay-loam. The soils are a bit acidic.

6. Flow of water from the sub-soil drains from the New Manurial Series

The sub-soil drains in the New Manurial Series plots which started discharging from 6th July 1959 had discharged 2,670,212 gallons of water by the 5th of September 1959 when they finally stopped. Though there were interruptions during the period of discharge, the total quantity of water discharged in 35 days was very much more than last year (1958), when they discharged 1,749,792 gallons during 45 days. This is the largest discharge on record ever since the drains were installed.

The drains had not commenced discharging by the end of July 1960, even though the rainfall had totalled 41.58 inches.

7. Analysis of Samples of Die-back Complex affected branches

Plant samples to study the deficiencies and nutrient imbalances if any in die-back affected plants and in different plants showing various malformations such as Witche's broom, snake-head and chlorotic leaves were collected and analysed. The analytical data is presented in Table C-18.

The following points are of interest in the data presented :

Nitrogen, Phosphorous, Potassium and Calcium are higher in leaves and stalks of die-back affected plants than in those of healthy plants. Boron content is a bit lower in leaves of die-back affected bush but not low enough to cause deficiency. In case of Witche's broom, NPK are low both in leaves and stalks, but not so in the case of snake-head. Total Calcium values are high in leaves but not in stalks, with the exception of Witche's broom where it is high.

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Ninety soil samples and 40 leaf samples from Balgunda, Tabore, Fairglen, Madapur, Guntenaik, Devadhanam, Neranki and Alageshwar estates were analysed.

The number of determinations carried out in the Division during the year are as follows :

1.	Moisture	1,083
2.	Loss on Ignition	214
3.	Insolubles	199
4.	pH.	458
5.	Total Nitrogen	777
6.	Organic Carbon	983
7.	Total P_2O_5	973
8.	Total Potassium	1,171
9.	Total Calcium	324
10.	Total R_2O_3	155
11.	Total MgO	191
12.	Total Fe_2O_3	164
13.	Available P_2O_5	20
14.	Available K_2O	30
15.	Conductivity	23
16.	Copper	1
17.	Boron	92
18.	Zinc	33
19.	Available Calcium	2
20.	Arsenic	25
21.	Nitrate Nitrogen	5
22.	Soil tests	42
23.	Tissue tests	432
24.	Total Ash	366
25.	Mechanical Analysis	484
	Total ...	8,247

Experiments at the Coffee Research Sub-Station, Chethalli, Coorg

1. NPK Trials with varying levels and combinations : Arabica.

2. NPK Trials with varying levels and combinations : Robusta.

3. Field Manurial Trials on Arabica. Concluded after the harvest of 1958–59.

4. Exploratory Test Scale Observational Trial on Arabica with varying doses of Nitrogen and constant levels of Phosphoric acid and Potash.

N. G. CHOKKANNA,
Director of Research
(*In Charge of the Division*)

TABLE C-1

Studies on the essential requirements of plant foods NPK for coffee in relation to improvement in yield—New manurial series : Yield record and percentage of floats in the harvest

Area of experimental plot : 76 cents.
No. of plants per sub-plot : 5 × 8 = 40 (up to January 1955)
Shade : Artificial, bamboo slats on pandal.
Spacing : Along the rows—10′. Along diagonal—7′.

Started : 1937.
No. of plants per sub-plot : 5 × 4 = 20 (from January 1955).
Layout : Latin Square.
Treatments : 5.
Replications : 5.

Annual Rate of manuring :—
Nitrogen 80 lb. to the acre in three equal doses.
Phosphoric acid 45 lb. to the acre in two equal doses.
Potash 60 lb. to the acre in two equal doses.

Year and particulars	Average yield of ripe cherry in lb. and clean coffee in cwts. calculated to the acre. Percentage of floats in the harvest — Treatments					Standard error as per cent of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	A N	B NP	C NK	D NPK	E Control				
1959 Cherry	5686	6274	5531	6038	5172	6.64	1181	No	BDACE
1960 Cherry	340	338	411	457	136	2.56	268	No	DCABE
1959 Clean Coffee	7.81	8.61	7.15	8.10	6.71	3.38	2.19	No	BDACE
1960 Clean Coffee	0.48	0.48	0.68	0.68	0.22	20.04	0.31	Yes	DCBAE
Average Ripe Cherry for 20 years ...	2292	2672	2359	2610	1965	3.76	276	Yes	BDCA, E
Average Clean Coffee for 12 years ...	5.01	5.99	4.92	5.46	4.06	3.27	0.52	Yes	BDAC, E
1959 percentage of floats by weight ...	8.60	9.80	9.50	9.52	9.74	5.65	1.64	No	BEDCA
1959 percentage of floats by volume ...	9.22	10.94	10.42	9.90	10.50	6.89	2.16	No	BECDA
1960 percentage of floats by weight ...	14.58	12.00	16.26	13.54	16.48	15.60	7.29	No	ECADB
1960 percentage of floats by volume ...	19.18	20.34	21.20	18.20	25.34	20.23	12.99	No	ECBAD

TABLE C–2

Studies on the effect of varying doses of Nitrogen with constant levels of P_2O_5 and K_2O on the growth and yield of coffee : Yield record

Area of experimental plot : 1.13 acres.

Layout : Latin Square.

No. of plants per sub-plot : Gross—$7 \times 7 = 49$. Nett—$5 \times 5 = 25$

Treatments : 5.

Variety of coffee : Nett—Kent's Clones. Inner border rows—Kent's seedlings. Guard rows—S–983 seedlings.

Replications : 5.

Annual rate of manuring :

A : Control—No Manure.
B : 80 lb. Nitrogen, ... 30 lb. Phosphoric acid ... 40 lb. Potash to the acre per annum.
C : 100 lb. ,, ... 30 lb. ,, ... 40 lb. ,,
D : 60 lb. ,, ... 30 lb. ,, ... 40 lb. ,,
E : 40 lb. ,, ... 30 lb. ,, ... 40 lb. ,,

Year and particulars	Average yield of ripe cherry in lb. calculated to the acre — Treatments					Standard error as per cent of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	A	*B*	*C*	*D*	*E*				
1959 Ripe Cherry ...	1459	1565	1800	1210	1877	21.31	1039	No	ECBAD
1960 Ripe Cherry	1152	1121	2223	1773	1332	21.72	1018	No	CDEAB
Average of 4 years (Cherry).	1082	1491	1648	1332	1482	9.60	417	No	CBEDA

TABLE C-3

Studies on the effect of different sources of Nitrogen on the growth and yield of coffee yield record

Area of experimental plot : 0.98 acre.
Number of plants per sub-plot : Gross—7 × 6 = 42. Nett—5 × 4 = 20.
Shade : Natural mixed shade

Layout : Latin Square.
Treatments : 5.
Replications : 5.
Spacing : 6′ × 6′.
Planted : 1953.

Annual rate of manuring : Nitrogen 80 lb. to the acre applied in 3 doses—(1) Pre-blossom 30 lb. (2) Post-blossom 20 lb. (3) Post-monsoon 30 lb.
Phosphoric acid 30 lb. to the acre (To be applied in two equal doses Pre-blossom and Post-monsoon)
Potash 40 lb. to the acre ,, ,, ,,

Treatments—
A : Required quantity of Nitrogen applied as Chilean Nitrate.
B : Control (no manure).
C : Rquired quantity of Nitrogen applied as Calcium Ammonium Nitrate.
D : ,, ,, Urea
E : ,, ,, Ammonium Sulphate.

Year and particulars	Average yield of ripe cherry in lb. calculated to the acre — Treatments					Standard error as per cent of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	A	*B*	*C*	*D*	*E*				
1959 Ripe Cherry	1740	3108	3486	3384	2874	20.50	1845	No	C D B E A
1960 Ripe Cherry	1764	774	906	1074	2538	27.74	1226	No	E A D C B
Average for 2 years (Cherry).	1752	1998	2196	2232	2706	14.14	949	No	E D C B A

TABLE C-4

Studies on the effect of varying levels of Phosphoric acid and Potash with constant level of Nitrogen on the growth and yield of Arabica coffee : Yield record for the year 1959–1960

Area of experimental plot : 1 acre.
Treatments : 6.
No. of plants per sub-plot : Gross—$7 \times 5 = 35$. Nett—$5 \times 3 = 15$.
Shade : Natural mixed shade.

Layout : Simple Randomized.
Replications : 4.
Spacing : $6' \times 6'$.
Planted : July 1954.

Treatments—

A : 80 lb. Nitrogen only to the acre.
B : 80 lb. Nitrogen + 45 lb. P_2O_5 + 60 lb. K_2O to the acre.
C : 80 lb. Nitrogen + 45 lb. P_2O_5 + 40 lb. K_2O to the acre.
D : 80 lb. Nitrogen + 30 lb. P_2O_5 + 40 lb. K_2O to the acre.
E : 80 lb. Nitrogen + 30 lb. P_2O_5 + 60 lb. K_2O to the acre.
F : Control (no manure)

Treatments	Yield of ripe cherry in lb. per plot — Replications (1)	(2)	(3)	(4)	Mean	Calculated yield per acre	Standard error as per cent of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
A ...	64.5	35.7	25.2	13.7	34.8	2782				
B ...	9.1	32.7	26.7	29.0	24.4	1950				
C ...	33.0	20.3	33.3	29.0	28.9	2312	17.65	19.22	No	D A E C F
D ...	32.8	34.5	45.0	36.7	37.3	2980				
E ...	26.6	24.6	29.4	39.2	30.0	2396				
F ...	25.1	45.0	13.3	19.2	25.7	2052				

TABLE C-5

NPK Trials with Varying Levels and Combinations (Arabica Manurial Experiments) at the Coffee Research Sub-Station, Chethalli, Coorg.

Yield Data 1959–60

Area of experimental plot : 2.28 acres. *Layout :* Factorial design 4 × 2 × 2.

No. of plants per sub-plot : *Replications :* 3.

Gross : 7 × 7 = 49. *Planted :* $6\frac{1}{2}' \times 6\frac{1}{2}'$

Nett : 5 × 5 = 25.

Variety of Coffee : S-446, 2nd generation. *Shade :* Natural mixed shade.

Terraced and planted in August 1952. *First manuring :* May 1953.

Treatments :

Nitrogen at 4 levels N_o, N_1, N_2 and N_3.

N_o = 0 lb. N. N_1 = 60 lb. N. N_2 = 90 lb. N. N_3 = 120 lb. N acre.

Phosphoric acid at 2 levels P_o and P_1.

P_o = 0 lb. P_2O_5. P_1 = 30 lb. P_2O_5 per acre.

Potash at 2 levels K_o and K_1.

K_o = 0 lb. K_2O. K_1 = 40 lb. K_2O per acre.

Tables of mean yields in lb. per plant.

		N_o	N_1	N_2	N_3	Mean	
P_o.	...	34.86	39.87	40.02	37.24	6.33	S.E. = 0.51
P_1.	...	41.08	43.56	35.37	38.51	6.61	
Mean	...	6.33	6.95	6.28	6.31		

S.E. = 0.72

TABLE C-5—(*Contd.*)

	N_0	N_1	N_2	N_3	Mean	
K_0 ...	34.52	36.79	45.44	39.71	6.52	S.E. = 0.51
K_1 ...	41.42	46.64	29.95	36.04	6.42	
Mean ...	6.33	6.95	6.28	6.31		
			S.E. = 0.72			

	P_0	P_1	Mean	
K_0 ...	77.81	78.65	6.52	S.E. = 0.51
K_1 ...	74.18	79.87	6.42	
Mean ...	6.33	6.61		
		S.E. = 0.51		

None of the factors is significant.

TABLE C-6

Field trials to find out the maximum economic dose of Nitrogen and the role of Phosphates and Potash in balancing the Nitrogen utilisation—Yield record

Layout : Randomized. *Treatments :* Main–6, Sub–4. *Replications :* 3.

Spacing : 5′ × 5′. *Shade :* Natural mixed shade. *Started :* May 1956.

Treatments : Main 6—with 6 levels of Nitrogen from 0 lb. to 800 lb. to the acre annually with and without Phosphoric acid and Potash.

A	...	50 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre.
B	...	800 lb. Nitrogen + 360 lb. Phosphoric acid + 480 lb. Potash to the acre.
C	...	200 lb. Nitrogen + 90 lb. Phosphoric acid + 120 lb. Potash to the acre.
D	...	0 lb. Nitrogen + 0 lb. Phosphoric acid + 0 lb. Potash to the acre.
E	...	400 lb. Nitrogen + 180 lb. Phosphoric acid + 240 lb. Potash to the acre.
F	...	100 lb. Nitrogen + 45 lb. Phosphoric acid + 60 lb. Potash to the acre.

Sub-treatments :

1. Nitrogen with Phosphoric acid and Potash.
2. As in (one) + basal dressing of 1 lb. of finely ground Rock Phosphate per plant applied at the commencement of the experiment.
3. Nitrogen only + basal dressing of Rock Phosphate applied as above.
4. Nitrogen only.

Time and method of application : 50 lb. Nitrogen level given in two equated doses in March and October while all the rest are given in four equal doses in March, May, August and October—applied as a broad band within the drip circle of each plant under the leaf mulch.

Main Treatments	Yield of ripe cherry in lb. per plot of 9 plants. (Totals of 3 replications). Sub-treatments 1	2	3	4	Mean of main treatments.	Standard error. Main plot	Sub-plot	Critical difference as P=0·05 Main treatments	Sub-treatments	Significant or not. Main treatments	Sub-treatments	Conclusions.
1959—												
A ...	93.2	107.6	102.7	96.6	33.30							
B ...	122.1	119.5	129.9	118.2	40.80							
C ...	118.4	89.2	123.3	144.0	39.60	17.47	5.56	16.26	3.62	No	No	
D ...	119.3	120.8	110.3	109.5	38.30							Main ... F B C D E A
E ...	117.4	79.4	109.7	105.1	34.30							Sub. ... 4 3 1 2
F ...	100.9	135.9	129.6	135.0	41.80							
Mean of Sub-treatments	37.30	36.20	39.20	39.40								
1960—												
A ...	28.5	22.3	14.9	18.4	7.01							
B ...	27.7	29.5	24.7	22.6	8.71							
C ...	22.6	19.0	16.8	18.1	6.38	4.37	2.11	4.07	1.37	No	Yes	
D ...	24.9	18.0	20.3	21.0	7.02							Main ... B F D A E C
E ...	23.9	17.6	21.0	16.1	6.72							Sub ... 1 2 3 4
F ...	27.5	18.3	19.9	19.8	7.13							
Mean of Sub-treatments	8.62	6.93	6.53	6.44								

TABLE C-7

Studies of the effect of different sources of Nitrogen on the growth and yield of mature yielding coffee—Yield record

Locality : Shigode Estate.
Area of experimental plot : 1.5 acres. *Layout :* Latin Square. *Treatments :* 6. *Replications :* 6.
No. of plants per sub-plot : Gross—7 × 10 = 70. *Spacing :* 5′ × 5′ *Shade :* Natural mixed shade. Started in 1956.
Nett— 5 × 8 = 40.

Annual rate of manuring : Nitrogen 80 lb. to the acre applied in three doses.
Phosphoric acid 45 lb. to the acre applied in two equal doses.
Potash 60 lb. to the acre applied in two equal doses.

Treatments :
A ... Control—No manure.
B ... Required quantity of Nitrogen applied as Calcium Ammonium Nitrate.
C ... ,, ,, Ammonium Sulphate.
D ... ,, ,, Urea.
E ... ,, ,, Chilean Nitrate.
F ... ,, ,, Ammonium Sulphate Nitrate.

Year and particulars.	Average yield of ripe cherry in lb. calculated to the acre. Treatments.						Standard error as % of gen. mean.	Critical difference P=0·05	Significant or not.	Conclusions.
	A	*B*	*C*	*D*	*E*	*F*				
1959 Ripe Cherry ...	2686	2193	2737	3026	2244	2465	1126	884	No	D C A F E B
1960 Ripe Cherry ...	2624	2742	2776	3058	2555	2588	11.05	965	No	D C B A F E
Average for 3 years.	2660	2483	2729	2790	2410	2528	5.89	452	No	D C A F B E

TABLE C-8A

Field manurial trials in private estates on Arabica coffee—Yield data

Treatments : Main–4. Sub–4.
No. of plants per sub-plot : Gross—10 × 7 = 70.
Nett—8 × 5 = 40.
Layout : Randomized split plot.
Shade : Natural mixed shade.
Started : 1954.

Main Treatments :
A. Nitrogen at 40 lb. to the acre per annum.
B. Nitrogen at 60 lb. to the acre per annum.
C. Nitrogen at 80 lb. to the acre per annum.
D. Nitrogen at 100 lb. to the acre per annum.

Sub-treatments :
N_1 ... The required quantity of Nitrogen applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.
N_2 ... The required quantity of Nitrogen applied in three doses ; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon periods.
NP ... The required quantity of Nitrogen applied as above (N2) + 30 lb. Phosphoric acid to the acre applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.
NPK ... As in NP above + 40 lb. Potash to the acre applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.

Main Treatments.		Yield of ripe cherry in lb. per plant (Totals of replications) — Sub-treatments. N_1	N_2	NP	NPK	Mean of main treatments	Standard error — Main plots	Standard error — Sub-plots	Critical difference P = 0.05 — Main treatments	Critical difference P = 0.05 — Sub-treatments	Significant or not — Main treatments	Significant or not — Sub-treatments	Conclusions
Urvinkhan Estate—Mudegere zone, Mysore : Spacing 6′ × 6′ : Replications 2.													
1959	A ...	3.5	7.3	5.9	4.8	2.7							
	B ...	6.0	4.7	4.0	5.4	2.5							
	C ...	4.5	5.3	5.7	4.5	2.5	2.02	0.59	3.21	0.65	No	No	Main : D A B C
	D ...	6.9	7.4	5.8	5.1	3.2							Sub : N_2 NP N_1 NPK
Mean of sub-treatments		2.6	3.1	2.7	2.5								
1960	A ...	8.1	12.0	5.9	10.2	4.5							
	B ...	8.6	8.4	6.4	7.5	3.8							
	C ...	8.1	7.1	8.9	7.5	4.0	0.87	0.86	1.39	0.94	No	No	Main : A C B D
	D ...	6.8	6.5	9.5	7.5	3.8							Sub : N_2 NPK N_1 NP
Mean of sub-treatments		4.0	4.3	3.8	4.1								

Togarihankal Estate—Chickmagalur zone, Mysore : Spacing : 6′ × 6′. Replications : 3.													
1959	A	...	3.7	7.8	4.7	4.9	1.8						
	B	...	4.3	2.4	4.8	3.6	1.3						
	C	...	3.6	3.6	3.2	3.6	1.2	0.83	0.61	0.83	0.51	No	No
	D	...	6.9	4.8	4.1	5.8	1.8						
Mean of sub-treatments			1.5	1.6	1.4	1.5							
1960	A	...	15.3	20.7	18.2	20.3	6.2						
	B	...	20.3	30.3	21.3	28.3	8.4						
	C	...	21.2	18.9	16.0	20.8	6.4	1.47	3.12	1.47	2.63	Yes	No
	D	...	23.3	23.2	31.2	14.9	7.6						
Mean of sub-treatments			6.7	7.8	7.2	7.0							
Sulgode Estate—Saklespur Zone : Spacing : 5′ × 5′ Replications : 3													
1959	A	...	1.5	3.0	1.5	1.8	0.7						
	B	...	2.5	1.7	1.2	3.1	0.7						
	C	...	2.8	1.6	2.6	3.4	0.9	0.58	0.50	0.58	0.42	No	No
	D	...	1.5	2.8	2.8	2.7	0.8						
Mean of sub-treatments			0.7	0.8	0.7	0.9							
1960	A	...	3.5	4.3	4.1	4.6	1.4						
	B	...	5.4	2.7	3.1	4.8	1.3						
	C	...	4.6	4.2	5.8	4.3	1.6	1.07	0.50	1.07	0.43	No	No
	D	...	2.6	4.4	3.9	2.5	1.1						
Mean of sub-treatments			1.3	1.3	1.4	1.4							
Merthikhan Estate—North Mysore : Spacing : 6′ × 6′. Replications : 3.													
1959	A	...	21.0	19.1	17.0	24.0	6.8						
	B	...	16.7	17.5	21.6	16.8	6.1						
	C	...	22.0	18.6	23.2	18.9	6.9	1.01	1.08	1.01	0.91	No	No
	D	...	17.6	20.5	21.1	20.2	6.6						
Mean of sub-treatments			6.4	6.3	6.9	6.7							

	Main : D A B C
	Sub : N_2 N_1 NPK NP
	Main : B D C A
	Sub : N_2 NP NPK N_1
	Main : C D B A
	Sub : NPK N_2 N_1 NP
	Main : C A B D
	Sub : NP NPK N_1 N_2
	Main : C A D B
	Sub : NP NPK N_1 N_2

TABLE C-8A (*Contd.*)

Main Treatments			Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P = 0·05		Significant or not		Conclusions
			Sub-treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
			N_1	N_2	NP	NPK								
1960	A	...	11.0	8.0	10.0	12.1	3.4							
	B	...	8.1	8.5	9.9	7.3	2.8							
	C	...	6.8	7.5	7.9	8.7	2.6	1.25	0.67	1.25	0.57	No	No	Main : A D B C
	D	...	8.7	9.6	8.5	9.9	3.1							Sub : NPK NP N_1 N_2
Mean of sub-treatments			2.9	2.8	3.0	3.2								
Maruvahulla Estate—Kotagiri, Nilgiris :			Spacing : 6′ × 6′.				Replications : 3.							
1959	A	...	2.2	1.4	1.7	3.2	0.7							
	B	...	2.0	2.1	1.5	2.7	0.7							
	C	...	1.0	0.8	0.9	0.9	0.3	0.71	0.30	0.71	0.26	No	No	Main : A B D C
	D	...	1.6	1.2	1.3	0.8	0.4							Sub : NPK N_1 N_2 NP
Mean of sub-treatments			0.6	0.5	0.5	0.6								
1960	A	...	20.7	19.0	19.9	13.2	6.1							
	B	...	15.7	20.6	14.5	18.1	5.7							
	C	...	17.8	17.4	16.0	16.2	5.6	1.01	1.01	1.01	0.85	No	No	Main : A B C D
	D	...	14.1	14.9	22.1	13.5	5.4							Sub : NP N_2 N_1 NPK
Mean of sub-treatments			5.7	6.0	6.0	5.1								
Vasambadi Estate:—Shevaroys, Madras :			Spacing 5½′ × 5½′.				Replications 3.							
1959	A	...	14.1	12.3	12.9	10.5	4.2							
	B	...	11.5	10.6	8.5	9.7	3.4							
	C	...	9.7	9.6	11.2	9.4	3.3	1.17	0.89	1.17	0.75	No	No	Main : A B C D
	D	...	9.7	6.4	10.5	9.0	3.0							Sub : N_1 NP N_2 NPK
Mean of sub-treatments			3.8	3.2	3.6	3.2								

1960	A	...	24.5	28.0	25.5	28.6	8.9							
	B	...	25.6	25.1	22.0	27.0	8.3							
	C	...	19.8	21.0	21.6	24.2	7.2	2.76	1.47	2.76	1.24	No	No	Main : D A B C
	D	...	26.0	27.5	27.0	28.7	9.1							Sub : NPK N_2 N_1 NP
Mean of sub-treatments			8.0	8.5	7.9	9.0								
Coffee Research Sub-station: Chethalli :					Spacing 6′ × 6′.		Replications 3							
1959	A	...	6.3	7.5	8.8	5.1	2.3							
	B	...	6.4	9.4	5.9	4.6	2.2							
	C	...	10.1	6.8	6.6	6.1	2.5	1.51	1.09	1.51	0.88	No	No	Main : C A B D
	D	...	6.4	7.1	4.7	4.1	1.9							Sub : N_2 N_1 NP NPK
Mean of sub-treatments			2.4	2.6	2.2	1.6								
1960	A	...	3.3	2.5	4.9	3.0	1.1							
	B	...	2.9	2.6	5.8	2.3	1.1							
	C	...	2.5	3.5	2.9	2.4	0.9	0.65	0.53	0.65	0.45	No	No	Main : A B C D
	D	...	3.5	2.6	2.2	2.8	0.9							Sub : NP N_1 N_2 NPK
Mean of sub-treatments			1.0	0.9	1.3	0.9								

TABLE C-8B

Field Manurial Trials in Private Estates—Arabica

Yield of Cherry expressed as percentage of the means of N_1 and N_2

	Treatments			Merthi-khan	Urvin-khan	Sul-gode	Togari-hankal	Vasam-badi	Maruva-hulla	C.R.S.S.	Mean of seven estates
A :	40 lb. Nitrogen	N	...	100	100	100	100	100	100	100	100
	40 lb. Nitrogen	NP	...	104.4	59.0	79.8	101.0	104.9	100.0	168.5	102.4
	40 lb. Nitrogen	NPK	...	126.3	102.0	118.6	112.6	109.2	66.7	105.3	105.8
B :	60 lb. Nitrogen	N	...	100	100	100	100	100	100	100	100
	60 lb. Nitrogen	NP	...	120.0	75.3	76.3	83.5	86.9	80.0	223.5	106.5
	60 lb. Nitrogen	NPK	...	87.3	88.2	122.1	112.9	107.1	100.0	82.4	97.1
C :	80 lb. Nitrogen	N	...	100	100	100	100	100	100	100	100
	80 lb. Nitrogen	NP	...	110.7	115.6	133.5	79.1	105.9	90.6	94.7	104.3
	80 lb. Nitrogen	NPK	...	123.4	97.4	100.7	103.0	118.5	92.3	84.2	102.8
D :	100 lb. Nitrogen	N	...	100	100	100	100	100	100	100	100
	100 lb. Nitrogen	NP	...	92.1	143.9	114.0	135.1	101.7	152.1	73.7	114.7
	100 lb. Nitrogen	NPK	...	108.2	113.6	72.8	64.4	107.3	93.8	94.7	93.5

TABLE C-9

N.P.K. Trials with Varying Levels and Combinations (Robusta Manurial Experiments) at the Coffee Research Sub-Station, Chethalli, Coorg

Yield Data 1959–60

Area of experimental plot : 1.68 acre.

Layout : Factorial design 4 × 2 × 2.

No. of plants per sub-plot :
Gross 7 × 6 = 42.
Nett 5 × 4 = 20

Replications : 3.

Planted : 13′ × 13.′

Planted : In September 1954.

Shade : Natural mixed shade.

Treatments :

Nitrogen at 4 levels N_o, N_1, N_2 and N_3.

N_o = 0 lb. N. N_1 = 60 lb. N. N_2 = 90 lb. N. N_3 = 120 lb. N/acre.

Phosphoric acid at 2 levels P_o and P_1.

P_o = 0 lb. P_2O_5. P_1 = 45 lb. P_2O_5 per acre.

Potash at 2 levels, K_o and K_1.

K_o = 0 lb. K_2O. K_1 = 60 lb. K_2O per acre.

Tables of mean yields in lb. per plant.

		N_o	N_1	N_2	N_3	Mean	
P_o	...	24.06	21.96	18.30	21.19	3.56	S.E. = 0.29
P_1	...	14.95	21.29	22.90	23.06	3.43	
Mean	...	3.25	3.60	3.43	3.69		
				S.E. = 0.41			

		N_o	N_1	N_2	N_3	Mean	
K_o	...	24.73	21.37	19.15	24.22	3.73	S.E. = 0.29
K_1	...	14.28	21.88	22.05	20.03	3.26	
Mean	...	3.25	3.60	3.43	3.69		
				S.E. = 0.41			

		K_o	K_1	Mean	
P_o	...	50.78	34.73	3.56	S.E. = 0.29
P_1	...	38.69	43.51	3.43	
Mean	...	3.73	3.26		
			S.E. = 0.29		

Minor effect due to P × K is significant.
C.D. at P = 0.05 for P × K = 1.16.

TABLE C 10-A

Field manurial trials in private estates on Robusta—Yield record

Treatments : Main–4. Sub–4. *Layout :* Randomized split plot. *Shade :* Natural mixed shade.

No. of plants per sub-plot : Gross—7 × 6 = 42. *Nett :* 5 × 4 = 20. *Started in* 1955.

Main treatments :—
A. Nitrogen at 40 lb. to the acre per annum.
B. „ 60 lb. to the acre per annum.
C. Nitrogen at 80 lb. to the acre per annum.
D. „ 100 lb. to the acre per annum.

Sub-treatments :—
N_1 ... The required quantity of Nitrogen applied in two equal doses once in the pre-blossom and once in the post-monsoon periods.
N_2 ... The required quantity of Nitrogen applied in three doses ; once in the pre-blossom, once in the pre-monsoon and once in the post-monsoon season.
NP ... The required quantity of Nitrogen applied as above (N_2) + 30 lb. Phosphoric acid to the acre applied in two equal doses once in pre-blossom and once in the post-monsoon season.
NPK ... As in NP above + 40 lb. Potash to the acre applied in two equal doses once in pre-blossom and once in the post-monsoon season.

Main treatments		Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P = 0.05		Significant or not		Conclusions
		Sub-treatments					Main plots	Sub plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
		N_1	N_2	NP	NPK								
Sulgode Estate—Saklespur zone, Mysore : Spacing : 10′ × 10′. Replications : 3.													
1959	A ...	33.9	29.4	26.3	31.0	10.1							
	B ...	32.2	28.0	28.1	39.5	10.7							
	C ...	21.9	26.5	19.5	30.3	8.2	2.08	3.00	2.08	2.53	Yes	No	Main : B A C D
	D ...	17.8	20.1	23.7	28.7	7.5							Sub : NPK N_1 N_2 NP
Mean of sub-treatments		8.8	8.7	8.1	10.8								
1960	A ...	33.6	34.6	29.3	23.0	10.0							
	B ...	26.3	28.6	26.7	38.1	10.0							
	C ...	37.4	35.8	39.9	44.1	13.1	3.25	3.32	3.25	2.79	No	No	Main : C D A B
	D ...	33.2	30.5	32.2	41.8	11.5							Sub : NPK N_1 N_2 NP
Mean of sub-treatments		10.9	10.8	10.7	12.2								

Chellote Estate—Kalpetta, Wynaad : Spacing 10′ × 10′. Replications 2.													
1959	A	...	17.2	20.7	16.5	20.9	9.4						
	B	...	15.7	25.1	22.8	22.6	10.8						
	C	...	14.1	13.0	16.6	16.6	7.5	1.84	1.71	2.92	1.87	No	No
	D	...	13.5	12.0	14.0	18.6	7.3						
Mean of sub-treatments			7.6	8.9	8.7	9.8							
1960	A	...	9.8	7.3	7.9	9.4	4.3						
	B	...	7.4	8.8	8.7	10.7	4.5						
	C	...	6.7	7.7	8.7	7.3	3.8	0.99	0.76	1.21	0.78	No	No
	D	...	6.4	5.8	7.5	6.2	3.2						
Mean of sub-treatments			3.8	3.7	4.1	4.2							

North Carolina Estate—Kalpetta, Wynaad : Spacing, Replications I and II 10′ × 10′. Replication III 9′ × 9′. Replications 3.													
1959	A	...	40.3	30.2	34.0	38.5	12.8						
	B	...	40.1	39.9	38.5	40.1	13.7						
	C	...	46.8	51.2	49.7	40.9	15.7	4.60	3.32	4.60	2.80	No	No
	D	...	46.2	50.3	55.8	66.2	18.2						
Mean of sub-treatments			15.0	14.3	14.9	15.5							
1960	A	...	9.1	7.6	6.9	9.0	2.7						
	B	...	7.3	8.1	9.1	6.9	2.6						
	C	...	10.9	10.4	6.7	6.2	2.9	1.53	0.57	1.52	0.48	No	No
	D	...	7.6	6.0	7.9	8.0	2.5						
Mean of sub-treatments			2.9	2.7	2.6	2.5							
1959	A	...	17.3	16.2	20.6	17.4	5.9						
	B	...	22.4	20.7	18.3	21.0	6.9						
	C	...	17.9	18.0	22.0	16.4	6.2	2.80	1.20	2.80	1.01	No	No
	D	...	15.1	21.1	21.2	15.5	6.1						
Mean of sub-treatments			6.1	6.3	6.8	5.9							

1959	Main : B A C D Sub : NPK, N_2, NP, N_1
1960	Main : B A C D Sub : NPK, NP, N_1, N_2
1959	Main : D C B A Sub : NPK, N_1, NP, N_2
1960	Main : C A B D Sub : N_1, N_2, NP, NPK
1959	Main : B C D A Sub : NP, N_1, N_2, NPK

TABLE C 10-A—*(Contd.)*

Main treatments	Yield of ripe cherry in lb. per plant (Totals of replications)				Mean of main treatments	Standard error		Critical difference P = 0.05		Significant or not		Conclusions
	Sub-treatments					Main plots	Sub-plots	Main treatments	Sub-treatments	Main treatments	Sub-treatments	
	N_1	N_2	NP	NPK								
Krishna Estate—Kalpetta, Wynaad : Spacing 9′ × 9′. Replications 3.												
1960 A ...	8.4	12.0	10.9	13.2	3.7							
B ...	10.0	15.0	10.9	13.9	4.2							
C ...	11.7	13.6	15.0	13.5	4.5	1.07	1.02	1.07	0.85	No	No	Main : C B D A
D ...	10.7	11.0	11.1	13.6	3.9							Sub : NPK, N_2, NP, N_1
Mean of sub-treatments	3.4	4.3	3.9	4.5								
Pathripara Estate—Kalpetta, Wynaad : Spacing 9′ × 9′. Replications 3.												
1959 A ...	34.2	35.519	30.0	55.1	12.9							
B ...	35.8	41.3	43.3	32.7	12.8							
C ...	46.2	28.2	34.3	29.1	11.5	4.96	3.15	4.96	2.66	No	No	Main : D A B C
D ...	34.3	44.0	46.3	68.0	16.1							Sub : NPK, NP, N_1, N_2
Mean of sub-treatments	12.5	12.4	12.8	15.4								
1960 A ...	19.0	16.6	26.8	12.8	6.3							
B ...	23.1	23.3	17.6	25.7	7.5							
C ...	18.2	15.2	20.7	16.8	5.9	2.34	1.89	2.34	1.59	No	No	Main : B D A C
D ...	19.0	25.1	22.1	21.5	7.3							Sub : NP, N_2, N_1, NPK
Mean of sub-treatments	6.6	6.7	7.3	6.4								

TABLE C 10-B

Field Manurial Trials in Private Estates—Robusta

Yield of Cherry expressed as percentage of the means of N_1 and N_2

Treatments		Krishna	Pathri-para	North Carolina	Chellote	Sulgode	Means of five estates
Main	Sub.						
A : 40 lb. N_2	N	100	100	100	100	100	100
40 lb. N_2	NP	106.8	150.6	83.6	92.5	86.0	103.9
40 lb. N_2	NPK	129.3	71.8	109.1	110.1	67.4	97.5
B : 60 lb. N_2	N	100	100	100	100	100	100
60 lb. N_2	NP	85.4	76.0	117.7	107.4	97.4	96.8
60 lb. N_2	NPK	108.2	111.0	90.2	130.8	138.8	115.8
C : 80 lb. N_2	N	100	100	100	100	100	100
80 lb. N_2	NP	119.1	124.1	62.9	120.9	109.1	107.2
80 lb. N_2	NPK	107.2	100.7	58.9	101.4	120.6	97.8
D : 100 lb. N_2	N	100	100	100	100	100	100
100 lb. N_2	NP	102.5	100.8	115.0	122.9	101.2	108.5
100 lb. N_2	NPK	124.7	98.1	115.0	101.6	131.3	114.1

TABLE C-11

Modified Robusta manurial trials laid out in private estates—Yield data—Series I

Layout : Latin Square. *Treatments :* 6. *Replications :* 6. *Shade :* Natural mixed shade. *Started :* 1956.

No. of plants per sub-plot : —Nett —5 × 4 = 20 with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.

Treatments :—

A. 40 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre per annum.
B. 60 lb. Nitrogen + 30 lb. Phosphoric acid + 40 lb. Potash to the acre per annum.
C. 60 lb. Nitrogen + 45 lb. Phosphoric acid + 60 lb. Potash to the acre per annum.
D. 80 lb. Nitrogen + 60 lb. Phosphoric acid + 80 lb. Potash to the acre per annum.
E. 60 lb. Nitrogen + 60 lb. Phosphoric acid + 80 lb. Potash to the acre per annum.
F. 40 lb. Nitrogen + 60 lb. Phosphoric acid + 80 lb. Potash to the acre per annum.

} A basal dressing of 10 cwts. of finely ground Rock Phosphate is applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of application of fertilisers : Nitrogen applied in three doses once in the pre-blossom, once in the post-blossom and once in the post-monsoon period Phosphoric acid and Potash applied in two doses during the pre-blossom and post-monsoon periods.

Name of estates	Average yield of ripe cherry in lb. calculated to the acre — Treatments						Standard error as percentage of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
	A	B	C	D	E	F				
1959—										
1. Cheekanahally Estate, Saklespur ...	5712	5032	4080	5236	5712	4488	15.04	2230	No	AEDBFC
2. Harley Estate, Saklespur ...	2924	3604	3468	3536	2788	3468	13.99	1259	No	BDFCAE
3. Panchura Estate, Kalpetta, Wynaad	4788	4304	4465	4358	4304	3981	11.12	1431	No	ACDEBF
4. Maniangode Estate ...	1933	1890	2079	1582	1901	1890	8.62	464	No	CAEBFD
5. Huvinkadu Estate, South Coorg	4896	4964	4148	4488	4896	4488	8.61	1176	No	BAEDFC
6. Yemmengundi Estate, South Coorg ...	4624	4216	3876	4352	4284	4284	7.75	972	No	ADEFBC
7. Bankal Estate, Mudegere ...	9588	7752	8908	8432	10200	10200	7.99	2169	No	EFACDB
1960—										
1. Cheekanahally Estate, Saklespur	1632	1632	1496	1904	1496	1632	11.04	530	No	DAFBEC
2. Harley Estate, Saklespur ...	2388	2584	2176	2108	1768	2108	15.38	986	No	BACDFE
3. Panchura Estate, Kalpetta, Wynaad	3240	3294	2484	2808	2646	3240	13.19	1160	No	BFADEC
4. Maniangode Estate, ...	2322	2268	2862	2322	2862	2430	7.76	563	No	ECFADE
5. Huvinkadu Estate, South Coorg	3264	2992	2992	2448	3604	2856	13.33	1206	No	EACBFD
6. Yemmegundi Estate, South Coorg	695	2312	1496	1564	1292	1156	21.82	950	No	BDCEFA
7. Bankal Estate, Mudegere ...	5936	4420	4726	5236	5648	5828	6.92	1081	Yes	AFEDCB

TABLE C-12

Modified Robusta manurial trials laid out in private estates—Yield data—Series II

Layout : Latin Square. *Treatments* : 6. *Replications* : 6. *Shade* : Natural mixed shade. *Started* : 1956.

No. of plants per sub-plot :— Nett—5 × 4 = 20 with one common border row on either side and between each successive pair of sub-plots and a common guard row all round the plot.

Treatments —

A. N only at 60 lb./acre applied as Ammonium Sulphate
B. N as above + 45 lb. P_2O_5 per acre applied as Hyper Phosphate Reno
C. N as above + 60 lb. K_2O per acre applied as Muriate of Potash.
D. P_2O_5 at 45 lb. per acre + 60 lb. K_2O per acre applied as Hyper Phosphate Reno and Muriate of Potash respectively.
E. As in treatment B above + 60 lb. K_2O per acre applied as Muriate of Potash.
F. Control (No manure)

A basal dressing of 10 cwts. of finely ground agricultural limestone is to be applied broadcast and stirred into the top soil soon after marking out the plots during the commencement of the trial.

Time of application of fertilisers :— Nitrogen applied in three doses ; during the pre-blossom, post-blossom and post-monsoon periods. P_2O_5. and K_2O applied in two equal doses during the pre-blossom and post-monsoon periods.

Name of Estate	Average yield of ripe cherry in lb. calculated to the acre — Treatments A	B	C	D	E	F	Standard error as percentage of gen. mean	Critical difference P = 0.05	Significant or not	Conclusions
1959										
1. Cheekanahally Estate, Saklespur	5168	6256	6120	5916	6188	5508	14.72	2543	No	BECDFA
2. Harley Estate, Saklespur ...	2822	2876	3196	2958	2312	3196	12.23	1040	No	FCDBAE
3. Panchura Estate, Kalpetta, Wynaad	4734	3551	3497	4033	3712	3066	11.10	1232	No	ADEBCF
4. Maniangode Estate, Kalpetta, Wynaad ...	2106	2268	2646	2592	2862	1512	8.70	551	Yes	$\overline{ECDBA}$, F
5. Bankal Estate, Mudigere ...	6732	7276	7344	8092	5984	5984	10.32	2115	No	DCBAEF
1960—										
1. Cheekanahally Estate, Saklespur	1924	1686	2040	2108	1700	1788	12.37	639	No	DCAFEB
2. Harley Estate, Saklespur ...	1972	2312	1700	1836	2040	1632	9.59	530	No	BEADCF
3. Panchura Estate, Kalpetta, Wynaad ...	2986	2500	2576	2954	2673	1631	7.02	653	Yes	$\overline{ADEC}$B, F
4. Maniangode Estate, Kalpetta, Wynaad	2468	2511	1982	2333	2446	1334	8.24	666	Yes	$\overline{BAEDC}$, F
5. Bankal Estate, Mudigere ...	3808	4012	3672	3332	3604	3740	9.59	1047	No	BAFCED

TABLE C-13

Analytical data of seedlings collected from the nursery manurial trials—Series II

Averages of 3 *replications—values on moisture free basis*

Description of the sample		Total Nitrogen (Per cent)						Organic Carbon (Per cent)						Carbon/Nitrogen		
Treatments	Parts	First set	Second set	Third set	Fourth set	Fifth set	Sixth set	First set	Second set	Third set	Fourth set	Fifth set	Sixth set	First set	Second set	Third set
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
N_0	Leaves ...	3.091	3.718	3.382	4.282	4.212	3.768	43.14	45.82	43.91	40.70	41.26	54.76	13.8	12.0	13.0
	Stalks ...	4.081	5.047	1.421	1.593	1.660	1.660	39.06	42.25	47.02	49.99	42.70	44.07	9.7	8.3	32.9
	Roots ...	1.715	1.523	2.017	2.064	1.688	1.644	44.80	41.10	45.42	45.98	46.15	48.26	26.2	27.1	22.9
$N_0P_0K_0$	Leaves ...	3.260	4.073	3.241	4.108	4.108	3.911	43.48	46.49	43.88	39.97	40.08	55.87	13.3	11.5	13.6
	Stalks ...	4.009	2.363	1.337	1.551	1.750	1.506	38.82	42.98	46.81	49.80	48.89	44.54	9.4	10.0	35.1
	Roots ...	1.945	1.537	1.890	1.783	1.613	1.416	44.72	40.89	45.41	45.41	46.10	47.58	23.1	26.6	24.2
N_1	Leaves ...	3.743	4.316	3.720	4.328	4.281	3.308	43.69	47.22	43.63	42.00	38.85	53.74	11.7	10.7	11.7
	Stalks ...	3.961	2.207	1.590	1.632	1.570	1.766	39.60	38.80	47.39	49.82	47.61	45.59	10.2	17.8	29.8
	Roots ...	1.882	1.752	2.419	1.797	1.779	1.439	45.26	40.64	44.93	45.77	46.17	47.12	24.1	23.2	20.8
$N_1P_1K_1$	Leaves ...	3.598	4.136	3.492	4.429	4.373	4.100	42.98	45.42	43.70	43.45	41.14	55.53	12.2	11.0	12.5
	Stalks ...	4.226	2.313	1.643	1.700	1.450	1.670	38.98	41.32	46.74	50.01	47.18	45.62	9.6	11.9	28.5
	Roots ...	1.861	1.682	2.061	1.763	1.909	1.426	45.06	40.34	45.17	45.25	48.12	47.10	24.2	24.2	21.5
N_2	Leaves ...	3.405	4.152	3.933	4.535	4.644	3.991	42.71	46.64	43.52	41.66	40.96	52.98	12.9	11.3	11.1
	Stalks ...	4.033	2.113	1.645	1.746	1.530	1.875	39.15	41.17	46.74	49.41	46.95	45.14	9.7	19.6	28.5
	Roots ...	1.978	1.646	2.248	2.139	2.013	1.494	45.10	40.20	44.30	46.67	45.21	46.43	22.8	24.8	18.8

$N_2P_2K_2$	Leaves	...	3.622	4.177	3.746	4.430	4.804	3.969	42.25	46.02	41.73	41.20	41.75	52.78	12.5	10.7	11.2
	Stalks	...	4.419	2.147	1.685	1.759	1.970	1.871	39.08	36.73	46.40	49.98	47.09	44.52	8.9	16.6	28.2
	Roots	...	1.984	1.743	2.211	1.717	1.910	1.506	44.92	40.49	45.40	46.65	46.59	46.63	22.5	23.4	20.6
N_3	Leaves	...	3.767	4.420	3.775	4.644	4.718	4.035	42.61	45.59	42.50	40.81	41.43	53.60	11.4	10.3	11.3
	Stalks	...	4.540	2.367	1.749	1.922	1.810	2.012	39.43	39.97	47.05	42.78	48.33	45.83	8.8	17.0	27.1
	Roots	...	1.929	1.866	2.246	1.821	1.992	1.543	44.59	41.31	49.22	45.36	47.70	46.27	23.1	22.2	22.1
$N_3P_3K_3$	Leaves	...	3.840	4.712	3.967	4.354	4.842	3.338	43.42	48.80	41.05	39.54	42.87	53.42	11.4	10.4	9.9
	Stalks	...	4.105	2.256	1.671	1.628	1.940	1.941	39.47	41.26	46.69	49.80	46.59	44.80	9.9	18.3	28.1
	Roots	...	1.792	1.760	2.382	1.992	2.001	1.620	45.51	40.66	47.18	44.02	44.73	46.30	25.4	23.1	20.8
N_4	Leaves	...	3.587	4.632	4.057	4.890	4.957	4.207	42.45	46.06	41.36	40.23	41.47	53.15	11.9	9.9	10.2
	Stalks	...	4.226	2.541	1.807	1.769	2.000	2.371	38.86	40.59	46.83	50.24	47.56	45.88	9.2	16.0	26.1
	Roots	...	2.015	1.920	2.251	1.813	1.995	1.832	44.77	40.91	46.48	43.94	46.59	47.22	22.3	21.5	20.7
$N_4P_4K_4$	Leaves	...	3.340	4.632	4.052	4.628	...	4.353	42.36	45.74	43.35	41.35	...	50.30	10.9	9.8	10.8
	Stalks	...	4.057	2.657	1.963	1.644	...	2.189	39.28	41.55	46.59	49.67	...	44.10	9.7	16.6	23.3
	Roots	...	2.002	1.879	2.369	1.898	...	1.727	45.20	40.39	46.31	43.84	...	45.41	22.7	21.5	19.9
N_5	Leaves	...	3.671	4.663	4.578	4.837	5.071	4.006	41.79	44.08	45.66	39.40	40.29	48.78	11.4	9.5	10.0
	Stalks	...	4.106	2.814	1.890	2.375	1.770	2.244	39.22	46.65	46.75	51.31	46.97	46.28	9.7	16.6	25.4
	Roots	...	2.002	1.940	2.189	1.948	2.028	1.801	45.47	40.97	45.65	44.32	46.83	45.17	22.8	21.3	20.5
$N_5P_5K_5$	Leaves	...	3.731	4.652	4.466	4.420	...	3.901	42.14	44.29	44.46	39.69	...	52.42	11.4	9.5	9.9
	Stalks	...	3.623	2.634	2.004	2.196	...	2.167	39.28	39.76	46.74	51.84	...	45.62	10.9	15.1	23.4
	Roots	...	1.941	1.880	2.415	2.044	...	1.873	44.33	41.14	45.12	44.39	...	46.24	22.9	22.0	19.1

TABLE C-13 (*Contd.*)

Analytical data of seedlings collected from the nursery manurial trials—Series II

Averages of 3 replications—values on moisture free basis

Description of the sample		Carbon/Nitrogen			Total P_2O_5 (Per cent)						Total K (Per cent)					
Treatments	Parts	Fourth set	Fifth set	Sixth set	First set	Second set	Third set	Fourth set	Fifth set	Sixth set	First set	Second set	Third set	Fourth set	Fifth set	Sixth set
		(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)
N_0	Leaves ...	9.6	9.8	14.5	0.433	0.629	0.792	0.669	0.443	0.545	3.658	3.448	4.165	4.373	3.849	2.781
	Stalks ...	31.5	30.0	26.7	0.356	0.267	0.340	0.290	0.219	0.236	2.242	1.718	2.040	1.694	1.369	1.326
	Roots ...	22.5	27.6	29.4	0.199	0.550	0.313	0.371	0.212	0.191	2.866	1.331	1.465	1.817	1.027	1.034
$N_0P_0K_0$	Leaves ...	9.8	9.8	14.2	0.546	0.692	0.853	0.588	0.437	0.547	3.700	4.053	4.422	4.257	3.912	2.592
	Stalks ...	32.2	28.2	29.4	0.452	0.270	0.417	0.237	0.196	0.258	2.253	1.917	2.260	1.780	1.316	1.376
	Roots ...	25.5	28.7	34.0	0.296	0.435	0.291	0.338	0.208	0.171	3.326	1.570	1.531	1.519	0.984	1.154
N_1	Leaves ...	9.9	9.1	14.1	0.554	0.653	0.817	0.684	0.398	0.558	3.012	4.457	4.058	4.413	4.004	2.557
	Stalks ...	30.6	30.4	25.8	0.452	0.293	0.376	0.321	0.158	0.251	2.153	2.150	2.573	1.749	1.427	1.447
	Roots ...	25.7	26.0	33.1	0.261	0.262	0.268	0.266	0.205	0.178	2.509	1.407	1.540	1.536	0.989	1.016
$N_1P_1K_1$	Leaves ...	9.9	9.5	13.6	0.556	0.676	0.820	0.448	0.399	0.522	2.730	4.748	4.021	5.216	4.411	3.279
	Stalks ...	29.5	32.5	27.3	0.563	0.300	0.375	0.233	0.156	0.190	2.189	2.341	2.550	1.877	1.466	1.400
	Roots ...	25.9	24.2	33.1	0.232	0.267	0.287	0.253	0.178	0.149	2.896	1.374	1.568	1.848	1.084	1.098
N_2	Leaves ...	9.2	8.9	13.3	0.522	0.687	0.813	0.511	0.400	0.505	3.955	3.914	4.130	4.372	4.564	2.687
	Stalks ...	28.5	29.7	23.8	0.330	0.283	0.385	0.148	0.153	0.220	2.154	2.117	2.530	1.692	1.454	1.392
	Roots ...	21.9	22.5	31.2	0.230	0.453	0.282	0.236	0.134	0.185	3.071	1.352	1.582	1.505	1.018	1.061

$N_2P_2K_2$	Leaves	...	9.3	8.7	13.3	0.558	0.623	0.816	0.496	0.423	0.461	2.801	4.809	4.989	5.146	5.057	3.209
	Stalks	...	28.4	23.1	24.1	0.280	0.267	0.360	0.168	0.163	0.195	2.310	2.216	2.583	1.918	2.452	1.353
	Roots	...	27.2	24.4	31.1	0.271	0.384	0.272	0.233	0.190	0.187	3.384	1.089	1.773	1.458	0.987	1.108
N_3	Leaves	...	8.9	8.8	13.3	0.589	0.618	0.815	0.516	0.377	0.366	4.060	3.844	4.278	4.194	4.090	2.682
	Stalks	...	26.0	26.7	22.8	0.260	0.207	0.446	0.135	0.139	0.191	2.361	1.992	2.537	1.979	1.918	1.293
	Roots	...	24.9	23.9	30.0	0.310	0.536	0.235	0.208	0.138	0.174	3.045	1.497	1.517	1.243	0.887	0.965
$N_3P_3K_3$	Leaves	...	9.5	8.9	16.3	0.530	0.613	0.778	0.468	0.408	0.396	3.492	4.933	4.692	5.591	5.928	3.621
	Stalks	...	29.5	24.0	23.2	0.222	0.253	0.348	0.134	0.175	0.193	1.029	2.274	2.533	2.127	1.588	1.186
	Roots	...	22.1	22.4	27.8	0.272	0.604	0.247	0.214	0.143	0.175	3.061	1.776	1.694	1.524	1.146	1.122
N_4	Leaves	...	8.2	8.4	12.6	0.562	0.646	0.748	0.588	0.322	0.244	3.497	4.752	4.292	4.603	3.884	2.553
	Stalks	...	28.2	23.8	19.4	0.366	0.217	0.389	0.218	0.151	0.169	2.171	1.942	2.450	1.839	1.176	1.194
	Roots	...	24.2	23.4	25.8	0.322	0.568	0.287	0.214	0.104	0.146	3.348	1.765	1.453	1.240	0.752	0.860
$N_4P_4K_4$	Leaves	...	9.0	...	11.6	0.523	0.633	0.813	0.450	...	0.303	3.006	4.965	4.540	6.040	...	3.837
	Stalks	...	27.1	20.2	20.2	0.388	0.310	0.379	0.234	...	0.149	2.020	2.424	2.677	1.733	...	1.420
	Roots	...	23.1	...	26.3	0.217	0.525	0.288	0.236	...	0.118	3.398	1.480	1.577	1.202	...	1.017
N_5	Leaves	...	9.2	8.0	11.9	0.524	0.604	0.776	0.470	0.309	0.467	2.919	4.340	3.732	4.345	3.817	2.794
	Stalks	...	21.4	26.5	20.7	0.396	0.190	0.357	0.168	0.224	0.157	2.153	2.051	2.303	1.359	1.084	1.209
	Roots	...	22.8	23.1	25.2	0.261	0.546	0.318	0.184	0.093	0.150	2.876	1.592	1.990	1.246	0.669	0.993
$N_5P_5K_5$	Leaves	...	9.0	...	13.4	0.525	0.554	0.770	0.450	...	0.503	3.087	4.745	4.999	6.060	...	3.176
	Stalks	...	24.8	...	21.1	0.314	0.270	0.408	0.167	...	0.193	2.069	2.091	2.793	1.877	...	1.411
	Roots	...	21.7	...	24.7	0.256	0.607	0.337	0.223	...	0.191	3.081	1.832	1.613	1.313	...	1.280

TABLE C 14-A

Analytical Data of Soil Samples from the Nursery Manurial Trials—Series II

Samples collected in July 1958 after the conclusion of the experiment

CHEMICAL ANALYSIS

Particulars		Moisture %	Nitrogen %	Organic Carbon %	C/N	Loss on Ignition %	Total P_2O_5 %	Total K_2O %	R_2O_3 %	CaO %
N_o	...	3.44	0.440	5.04	11.4	12.2	0.0901	0.727	13.46	0.526
N_o P_o K_o	...	4.37	0.424	5.28	12.5	11.4	0.0951	0.583	13.34	0.739
N_1	...	4.53	0.432	5.77	13.3	10.6	0.0986	0.333	13.90	0.484
$N_1P_1K_1$	...	4.66	0.471	5.12	10.9	11.1	0.0319	0.678	12.46	0.614
N_2	...	4.64	0.456	5.64	12.4	11.3	0.0288	0.213	12.13	0.411
$N_2P_2K_2$	...	3.77	0.473	5.52	11.7	11.8	0.0793	0.339	12.62	1.165
N_3	...	3.55	0.449	5.72	12.8	11.3	0.0557	0.457	11.46	0.364
$N_3P_3K_3$	...	3.55	0.478	5.51	11.6	11.0	0.1081	0.308	12.01	1.072
N_4	...	3.77	0.469	5.60	11.9	11.3	0.0674	0.474	11.90	0.551
$N_4P_4K_4$	...	4.01	0.464	5.94	12.8	10.6	0.1256	0.729	11.70	1.114
N_5	...	5.17	0.505	5.24	10.4	9.7	0.0521	0.456	10.93	0.520
$N_5P_5K_5$	...	4.96	0.489	5.00	10.3	9.8	0.0759	0.785	11.92	1.655

TABLE C 14-B

Analytical Data of Soil Samples from the Nursery Manurial Trials—Series II

Samples collected July 1958 after the conclusion of the experiment

MECHANICAL ANALYSIS

Particulars		Clay%	Silt%	Fine fraction%	Fine sand %	Coarse sand %	Coarse fraction%	Coarse fraction / Fine fraction	Loss by solution%
N_o	...	22.29	7.11	29.40	24.25	31.40	55.65	1.89	11.52
N_o P_o K_o	...	19.71	7.30	27.01	24.76	30.05	54.81	2.03	13.82
N_1	...	21.35	6.08	27.43	24.09	30.71	54.80	2.00	13.25
$N_1P_1K_1$	...	21.42	7.18	28.60	24.04	30.36	54.40	1.90	12.34
N_2	...	20.78	6.86	27.64	22.75	31.97	54.72	1.98	13.00
$N_2P_2K_2$	...	20.70	6.55	27.25	23.80	31.50	55.30	2.03	13.68
N_3	...	20.58	6.85	27.43	23.40	34.23	57.63	2.10	11.39
$N_3P_3K_3$	...	19.82	6.75	26.57	22.72	33.44	56.16	2.11	13.71
N_4	...	19.66	6.90	26.56	24.30	33.94	58.24	2.19	11.43
$N_4P_4K_4$	...	21.28	6.05	27.33	24.98	33.28	58.26	2.13	0.78
N_5	...	21.70	6.57	28.27	24.62	31.97	56.59	2.00	9.98
$N_5P_5K_5$	...	20.05	6.76	26.81	24.32	32.51	56.83	2.12	11.41

TABLE C-15

Analytical data of the leaf samples collected from different blocks of Coffee Research Station to correlate yield with Leaf Nitrogen

(*Values on moisture free basis*)

Name of the Block (with category)	Yield in cwts. per acre	First set collected before blossom (March)				Second set collected after blossom (April)				Third set collected before harvesting (December)							
										On cropping wood				On non-cropping wood			
		Total Nitrogen%	Total Ash%	Total P_2O_5%	Total K%	Total Nitrogen%	Total Ash%	Total P_2O_5%	Total K%	Total Nitrogen%	Total Ash%	Total P_2O_5%	Total K%	Total Nitrogen%	Total Ash%	Total P_2O_5%	Total K%
1. "J" Block-Medium yielding...	1.06	2.795	9.61	0.414	3.061	2.820	9.50	0.338	2.332	2.472	6.90	0.382	2.343	2.747	6.44	0.437	2.598
2. Crawford Area-Medium yielding	2.46	3.099	9.70	0.459	3.279	3.185	9.73	0.360	2.515	2.467	6.56	0.416	2.438	2.011	6.67	0.424	2.531
3. "P" Block-High yielding ...	5.10	3.247	10.59	0.435	2.486	2.970	12.48	0.372	1.914	2.435	6.17	0.400	2.329	2.533	7.31	0.336	2.642
4. "M" Block-Medium yielding.	1.40	2.378	9.05	0.378	2.507	2.943	9.51	0.293	2.122	2.861	7.16	0.376	2.447	2.521	8.16	0.390	2.773
5. "N" Block-High yielding ...	1.45	2.878	10.48	0.389	3.019	3.028	10.65	0.355	2.448	2.516	7.44	0.446	2.597	3.041	8.26	0.322	2.784
6. "E" Block-Medium yielding.	3.00	2.729	10.59	0.433	2.973	2.972	9.65	0.396	2.590	2.293	7.81	0.467	2.517	2.653	7.58	0.227	2.536
7. "T" Block-High yielding ...	1.19	2.990	10.95	0.371	2.761	3.159	9.48	0.356	2.221	2.571	6.65	0.424	2.262	2.590	8.20	0.363	2.536
8. "L_3" Valley-Low yielding ...	0.36	2.906	10.02	0.385	2.139	3.031	10.37	0.371	2.489	2.305	6.82	0.344	2.187	2.748	7.01	0.315	2.503
9. "L_1" Block-Low yielding ...	2.71	2.821	10.82	0.411	3.040	3.004	8.97	0.354	2.289	3.034	5.47	0.378	2.461	2.834	7.44	0.347	2.534

TABLE C-16

Analytical data of different parts of the Arabica coffees

(*Values on moisture free basis*)

Description		Young leaves	Old leaves	Third pair of leaves	Composite leaf sample	Berries	Primaries	Secondaries and tertiaries	Stem	Bark	Roots	Root-hairs
Organic Carbon :	*A.* S–795 ...	46.17	45.69	44.60	43.63	47.71	...	44.91	45.76	...	47.46	...
	B. Coorgs ...	43.52	44.41	43.28	43.74	47.39	46.99	45.73	47.22	42.87	47.35	44.39
	C. Kents ...	43.25	43.19	46.09	47.36	49.29	46.78	44.31	47.22	43.69	48.59	45.42
Nitrogen :	*A.* S–795 ...	3.10	3.04	2.88	3.65	3.281	...	1.77	1.10	...	1.64	...
	B. Coorgs ...	4.11	3.11	3.76	3.50	2.942	1.22	1.37	1.11	2.26	1.23	1.73
	C. Kents ...	3.50	3.70	3.51	3.59	3.457	1.21	1.68	0.99	3.03	1.68	2.07
C/N ratio :	*A.* S–795 ...	14.89	15.02	15.51	11.97	14.54	...	25.40	45.37	...	28.87	...
	B. Coorgs ...	10.58	13.05	11.52	12.50	16.11	38.65	33.51	42.67	18.94	48.49	25.72
	C. Kents ...	12.36	11.70	13.15	13.21	14.26	38.83	26.34	47.50	14.39	29.00	21.91
Phosphoric acid :	*A.* S–795 ...	0.611	0.588	0.507	0.438	0.342	...	0.507	0.208	...	0.219	...
	B. Coorgs ...	0.424	0.463	0.459	0.430	0.453	0.107	0.180	0.077	0.182	0.111	0.284
	C. Kents ...	0.481	0.339	0.342	0.425	0.358	0.156	0.191	0.099	0.250	0.135	0.176
Potassium :	*A.* S–795 ...	2.611	2.451	2.143	2.056	2.207	...	1.361	0.677	...	0.925	...
	B. Coorgs ...	3.729	3.007	3.586	3.103	2.175	0.494	0.806	0.332	0.927	0.497	1.687
	C. Kents ...	3.203	2.797	2.519	2.525	1.893	0.645	1.185	0.353	1.361	0.653	1.309
Calcium :	*A.* S–795 ...	0.542	0.932	0.411	0.437	0.282	...	0.359	0.145	...	0.745	...
	B. Coorgs ...	0.450	0.931	0.557	0.972	0.395	0.367	0.458	0.479	0.922	0.198	0.141
	C. Kents ...	0.604	0.686	0.763	0.440	0.261	0.277	0.391	0.262	1.106	0.192	0.181

A.—3-year old coffee *B.*—40-year old coffee. *C.*—15–20-year old coffee.

TABLE C-17

Analytical data of soil samples collected from New Manurial—Series I

(Values on moisture free basis)

CHEMICAL ANALYSIS

Treatments	Moisture %	Loss on Ignition %	Organic Carbon %	Total Nitrogen %	Carbon / Nitrogen	pH H_2O	pH KCl	Insolubles %	Total P_2O_5 %	Total K_2O %	Total R_2O_3 %	Total CaO %	Total MgO %
A. N ...	7.02	13.9	2.26	0.236	9.6	7.0	5.6	66.3	0.176	0.749	18.8	0.356	0.290
B. N + P ...	7.17	14.9	2.74	0.257	10.7	6.9	5.7	66.2	0.309	0.817	21.0	0.617	0.302
C. N + K ...	7.52	14.9	2.70	0.262	10.3	6.8	5.8	65.7	0.157	0.814	19.5	0.428	0.327
D. N + P + K ...	7.88	15.5	2.84	0.262	10.9	6.9	5.8	65.1	0.265	0.800	19.1	0.495	0.311
E. Control ...	6.77	13.6	2.33	0.245	9.5	7.1	6.0	64.5	0.181	0.854	19.2	0.497	0.421

MECHANICAL ANALYSIS

Treatments	Moisture %	pH H_2O	pH KCl	Silt %	Clay %	Fine fraction %	Fine sand %	Coarse sand %	Coarse fraction %	Coarse fraction / Fine fraction	Loss by solution %
A. N ...	7.02	7.0	5.6	8.45	38.42	46.87	22.15	18.68	40.83	0.833	5.55
B. N + P ...	7.17	6.9	5.7	9.04	39.95	48.99	21.12	18.09	39.21	0.773	6.36
C. N + K ...	7.52	6.8	5.8	9.89	39.79	49.68	20.17	18.86	39.03	0.873	3.56
D. N + P + K ...	7.88	6.9	5.8	9.78	40.98	50.76	18.54	16.19	34.73	0.772	6.52
E. Control ...	6.77	7.1	6.0	8.02	37.76	45.78	23.25	19.09	42.34	0.826	5.23

TABLE C-18

Analytical Data of Plant Samples Collected from Plants showing Die-Back and other Malformations

Samples collected on 8–6–1960. *Values on moisture free basis*

Description of the sample		Total Nitrogen %	Total Ash %	Total P_2O_5 %	Total K %	Total Ca %	Boron ppm
Healthy S.795	Leaves	2.959	6.49	0.396	2.518	0.811	31.0
Healthy S.795	Stalks	1.510	7.79	0.551	3.223	0.364	35.5
Kents Healthy	Leaves	2.794	6.61	0.388	2.195	1.139	29.5
Kents Healthy	Stalks	1.383	8.57	0.448	3.039	0.625	31.5
Kents affected (showing malformations) healthy.	Leaves	2.693	8.04	0.499	2.812	1.013	37.5
Kents affected (showing malformations) healthy.	Stalks	1.281	8.65	0.603	3.298	0.468	33.5
Kents die-back affected plant leaves on the die-back affected twig ...		3.272	11.15	0.476	4.024	1.040	25.0
Kents die-back affected plant green twigs on the die-back affected branch ...		1.485	9.82	0.382	3.768	0.591	36.0
Kents die-back affected plant dead twigs on the die-back affected branch ...		0.932	4.21	0.147	1.07	0.702	32.0
Kents showing multiple branching and with short internodes small leaves (Leaves on the affected branch) ...		1.968	8.90	0.241	3.023	0.676	35.0
Kents showing multiple branching and with short internodes small leaves (twigs on the affected branch) ...		1.080	6.97	0.128	2.151	0.792	36.0
Kents showing goose-neck or snake-hood (Leaves on the affected branch)		2.625	7.89	0.377	2.561	0.779	29.5
Kents showing goose-neck or snake-hood Stalks ...		1.380	5.94	0.382	3.290	0.476	32.0
Kents with chlorotic leaves—Affected leaves ...		2.925	7.48	0.511	3.142	0.706	31.5
Kents with chlorotic leaves—Affected stalks ...		1.270	5.01	0.364	2.843	0.511	24.5

IV. ENTOMOLOGY

During the year, the following fields of study were undertaken by the Division of Entomology.

A. Survey on the seasonal intensity of incidence of pests of coffee : Insects and nematodes (eelworms).

B. Applied Research : Observations on the Chemical Control experiments laid out in the field at the Coffee Research Station, Balehonnur and at various Liaison Zones.

C. Basic Research : (i) Laboratory and field studies on the habits, life history and ecological relationships of pests of coffee.

(ii) Recording the comparative abundance and activity of parasite species of coffee pests and related biological studies.

(iii) Collection, identification and preservation of insects obtained from light traps and other sources.

(iv) Examination of soil and plant samples for parasitic nematodes.

A. Survey on the Seasonal Intensity of Incidence of Pests of Coffee

The following pests of coffee received emphasis in the survey operations. They are arranged in the descending order of importance arbitrarily fixed for each.

(1) Nematodes :

(2) Green bug : *Coccus viridis* Gr.

(3) Shot hole borer : *Xyleborus morstatti* Hgdn.

(4) Red borer : *Zeuzera coffeae* Nietn.

(5) White stem borer : *Xylotrechus quadripes* Chev.

(6) Hairy caterpillar : *Eupterote* spp.

Nematodes continued to maintain major pest status. The incidence of these pest species, in varying degrees, was detected in the following estates :—

(*a*) Koppa—
- (1) Alageswara
- (2) Kerkikonda
- (3) Merthikhan
- (4) Coffee Research Station

(*b*) Chickmagalur—
- (1) Kurukanmatti
- (2) Tottlukhan

(*c*) Mudigere—
(1) Balur
(2) Neranki

(*d*) North Coorg—
(1) Canoncadoo
(2) Coovercolly (Dibidi Dn.)
(3) Cullaley (Cowcody Gr.)
(4) Madapur B
(5) Madapur II

(*e*) South Coorg—
(1) Balmane.
(2) Cottabetta (Nallagottay No. 23).

(*f*) Shevroys—
(1) Fairglen.
(2) Honeyrock.
(3) Tabore.

(*g*) Coimbatore—
(1) Attikhan.

(*h*) Nilgiris—
(1) Ampalkot Gardens.
(2) Lauriston.
(3) New Hope.
(4) Ranjita Plantations.

(*i*) Pulneys—
(1) St. Mary's.

The incidence of green bug was reported to be severe at Chickmagalur, Saklespur, Mudigere, Koppa, Shevroy and Nilgiri zones during the latter part of the year.

Shot hole borer incidence was, in general, low at the Coffee Research Station, Balehonnur, till January 1960, while beyond this period, the degree of incidence was thrice that for the corresponding period of 1958–59 (Table I). In North Kerala, increased incidence was evident from June 1960.

Mild infestations of red borer were reported from Mudigere and South Coorg areas. At the Coffee Research Station, Balehonnur, tracing red borer incidence in the five selected blocks (NMS, IV and V, L_2 Seed, 1955 Seed and J. blocks) and in the rest of the estate was continued. The data (Table II) for the period July 1959—June 1960 showed that the peak was reached in March. Of the selected blocks, NMS V (2.06 acres) had the highest degree of incidence. The selected blocks, as reported earlier (Ann. Rept. 1958–59), showed higher rate of incidence—7.8/acre—than the rest of the estate—1.7/acre. Incidence in the whole of the estate was about the same—3/acre—as that for 1958–59.

White stem borer infestation, in general, did not reach high levels in most of the zones though in the North Mysore Zone, the incidence was more than that in the previous year. At the Coffee Research Station, the incidence remained at about the same level as in the previous year—5/acre.

Incidence of hairy caterpillar species was reported high during February at Laxminivas and Koderi Estates, Nilgiris.

B. Applied Research—Laboratory and Field Experiments on the Chemical Control of Pests of Coffee

1. **White Stem Borer**—*Xylotrechus quadripes* Chev. (Coleoptera, Cerambycidae).

Three field experiments to assess the comparative effectiveness of B.H.C. 50 W.P. (at 1.0% a.c.)—applied twice and thrice per year—, Dieldrin 50 W.P. (at 0.125% a.c.), Heptachlor 25 W.P. (at 0.1% a.c.) and Gusathion 20 E.C. (at 0.1% a.c.)—applied twice per year were in progress in the following estates.

Expt.	Zone/Estate	Started on	Data analysed upto
1	Mudigere-Godhanda	... October, 1958.	April-May, 1960
2	North Coorg-Perumbucolly	... August, 1958	do.
3	Saklespur-Belagode	... do.	do.

EXPERIMENT 1

Details—Treatments : 6.
Replications : 4.
Plot size : 20 × 6 (120) plants—Gross.
18 × 4 (72) plants—Nett.
Layout : Randomized.

Analysis of Results (Table III)

The results were significant. B.H.C. applied twice or thrice and Gusathion applied twice were similar in effectiveness. There was no significant difference in effectiveness between B.H.C. applied thrice, Heptachlor and Dieldrin applied twice.

EXPERIMENT 2

Details—Treatments : 6.
Replications : 3.
Plot size : 20 × 6 (120) plants—Gross.
18 × 4 (72) plants—Nett.
Layout : Randomized.

Analysis of Results (Table III)

The results were significant. B.H.C. applied thrice, Dieldrin and Gusathion applied twice, were superior and there was no significant difference between them. The degrees of effectiveness of the latter two were significantly similar to those of Heptachlor and B.H.C. applied twice,

The above two experiments showed that B.H.C. applied thrice, and Gusathion applied twice, gave consistently superior control as compared to B.H.C. and Dieldrin applied twice. In general, Heptachlor showed lesser degree of efficacy.

EXPERIMENT 3

Details—Treatments : 6.
Replications : 3.
Plot size : 20 × 6 (120) plants—Gross.
18 × 4 (72) plants—Nett.
Layout : Randomized.

The results of this experiment were not significant so far.

Another experiment is in progress at Chennanahalli Estate, Chickmagalur (started in May 1959). Additional data have to be obtained from this experiment to attempt analysis.

EXPERIMENT 4 *Studies on the effects of B.H.C swabbing on Cup quality.*

Locality : Coffee Research Station, Balehonnur.

Three blocks at the Coffee Research Station were selected for the above studies. Each of these blocks were planned to receive insecticidal swabbing as indicated below. Incidence of borers would be recorded for additional information. Samples of coffee picked from the three experimental blocks during the last season have already been sent abroad for quality tests. Data are awaited.

Block/Area	Age of plants	Sequence of Swabbing
R–4.97 acres	30–35	No swabbing in either seasons beginning from April 1959.
L_1–2.43 acres	20–25 (and 8–10 years old selections).	No swabbing in October—beginning from April 1959 swabbing.
*Q—2 acres	30–35	No swabbing in April—beginning from October 1959 swabbing.

* Samples presently sent from this block would represent the Category—2 swabbings.

2. **Green Bug :** *Coccus viridis* Gr. (Hem. Homoptera, Coccidae).

EXPERIMENT 1—*Laboratory trials on the comparative effectiveness of Systemic and Nonsystemic Insecticides.*

Locality : Coffee Research Sub-station, Chethálli.
Started : May, 1960.
Details : Treatments—11.
Replications—4.

Materials and Methods : Two series of qualitative tests with the following insecticidal formulations, at 0.01% and 0.02% a.c. (active concentration) were conducted.

A. Basudin—20 E.C.
B. Gusathion—20 E.C.
C. Paramar—50 E.C.
D. Fosferno—50 E.C.
E. Isochlorothion—50 E.C.
F. Folidol—46.7 E.C.
G. Rogor—40 E.C. } Systemics.
H. Ekatin—20 E.C. } Systemics.
I. Meta-iso-systox—25 E.C. } Systemics.
J. Malathion—53 E.C.
K. Control.

Arabica twigs having a pair of leaves each, infested with almost uniform number of green bug, were allowed to establish in nutrient solution contained in conical flasks. Each such twig formed a replication and in a replication, one leaf was selected at random for observational counts of adult bugs on the petiole, upper and lower surfaces. Initial counts were carried out just before spraying the respective chemicals with an atomizer. Post-treatment observations on mortality were recorded at the intervals 36, 72 and 96 hours.

Analysis of Results (Table IV)

Low Concentration : None of the insecticides provided significant results at 36 hours after treatment. At 72 hours, Folidol was significantly superior to Malathion, Meta-iso-systox, Paramar and Rogor while there was no significant difference in effectiveness among the latter four chemicals. At 96 hours, Folidol and Malathion were equally potent and superior to the rest of which Paramar, Fosferno and Rogor came next. Also, there was no significant difference in effectiveness between Malathion and Paramar as also between Fosferno, Rogor, Meta-iso-systox and Isochlorothion.

High Concentration : As opposed to the above, at 36 hours, Basudin, Folidol and Malathion were significantly superior to the rest of the chemicals of which Meta-iso-systox, Paramar and Fosferno came next. There was no significant difference in effectiveness among Folidol, Meta-iso-systox, Paramar and Fosferno. At 72 hours, Basudin, Folidol, Fosferno

and Paramar were equally effective and superior to the remaining chemicals. There was no significant difference in effectiveness between Fosferno, Paramar and Gusathion. Meta-iso-systox, Malathion, Isochlorothion and Ekatin were less effective. At 96 hours, Folidol, Paramar and Basudin remained superior while the degrees of effectiveness of Paramar and Fosferno and those of Fosferno and Gusathion were statistically similar.

From the above, it appears that Folidol is consistently effective at both the levels of concentrations. Malathion, though comparably effective at low concentration, is surpassed by the greater degree of action of the high concentrations of Basudin, Fosferno, Paramar and Gusathion ; especially at 72 and 96 hours after treatment.

EXPERIMENT 2—*Spray trials with the Systemics, Rogor* 40 *E.C., Meta-iso-systox* 25 *E.C. and Ekatin* 20 *E.C.*

Locality : Gavikhan Estate, Chickmagalur.
Started : Series (i) March 10, 1960. (ii) April 15, 1960. (iii) May 7, 1960.

Details : Treatments—4.

	Series I	Series II	Series III
Chemicals at ...	0.01% a.c.	0.02% a.c.	0.04% a.c.
Replications (Plants) ...	4	5	5

Plot size : One plant with guard rows.
Layout : Randomized.

Methods

On each plant, three pairs of leaves carrying heavy and almost uniform infestations of green bug were selected (arbitrarily) at random. One leaf in each of the selected pairs was utilized for critical population counts—pre-treatment and post-treatment. Thus, on a plant (replication), populations were counted on three leaves. This procedure was followed for the remaining plants in the experiment. Post-treatment observations on the increase or decrease in bug population were conducted at 15, 25 and 35 days for Series I. For Series II and III, observational periods were extended up to 45 and 55 days respectively.

ANALYSIS OF RESULTS (TABLE V)

Series I : At 15 days after treatment, there was no significant difference in effectiveness between Rogor and Meta-iso-systox and these were superior to Ekatin and Control. At 25 days, the former two maintained their superiority while there was no significant difference between Meta-iso-systox and Ekatin. At 35 days, all the chemicals were on a par. Data, however, evidenced that pest build up commenced and progressed by the 25th day of the observational period on many of the sprayed plants in all the treatments.

Series II : At 15 days after treatment, Meta-iso-systox and Rogor were equally effective and superior to Ekatin and Control. At 25 days, the former was superior to Rogor and Ekatin was much less effective. Plants in the latter treatment showed gradual rebuild of pest infestation. Meta-iso-systox maintained it's superiority at 35 days also while there was no

significant difference between Rogor and Ekatin. At 45 days, Meta-iso-systox and Rogor were similar in effectiveness. Rebuild of pest infestation was noticed in all the treatments from the 35th day of the observational period; this being maximum in control with Ekatin, Rogor and Meta-iso-systox following in the descending order.

Series III : At 15 days, Rogor was significantly superior to the rest of the treatments while at 25 and 35 days, the effectiveness of Meta-iso-systox was equally comparable with that of Rogor. Ekatin, however, did not bring comparable reduction in pest population at 25 days and considerable rebuild of pest population was evident at 35 days. At 55 days, though the chemicals had brought about significant results, rebuild in pest population was marked in all ; this being maximum in control with Ekatin, Meta-iso-systox and Rogor following in the descending order.

The above observations would indicate that, of the three systemics, Rogor and Meta-iso-systox at 0.04% a.c. effect control for a maximum period of 25 days in the field.

EXPERIMENT 3—*Trials with Non-systemic Insecticides*—

Locality : Maruvahalla Estate, Nilgiris.
Started : June 25, 1960.
Details : Treatments—8.
Replications—(Leaves) 6.
Layout—Randomized.

Materials and Methods : The insecticides listed below were tested at 0.02% and 0.04% a.c.

A. Basudin—20 E.C.
B. Paramar—50 E.C.
C. Gusathion—20 E.C.
D. Fosferno—50 E.C.
E. Isochlorothion—50 E.C.
F. Folidol—46.7 E.C.
G. Malathion—53 E.C.
H. Control.

There were two plants per treatment. On each plant, three pairs of leaves carrying heavy infestations of green bug were selected at random and in each pair, one leaf was used for critical population counts on the petiole, upper and lower surfaces—initial as well as post-treatment. Thus, six leaves were counted per treatment at each observation. Post-treatment observations were conducted at the periods 10, 20, 30 and 45 days.

Analysis of Results (Table VI)

Low Concentration : At 10 and 20 days after treatment, Paramar, Fosferno and Folidol were significantly superior to the remaining treatments except Gusathion which came on a par with the above three at 20 days. Basudin was less effective at the above periods. At 30 days, however, Gusathion, Fosferno, Folidol and Paramar maintained significant similarity in

effectiveness, in the order mentioned, and these were superior to the rest. The same trend was observed at 45 days also. Among the chemicals, Basudin, Isochlorothion and Malathion showed pest build up from the 30th day of the observational period. Slight trend toward pest build up was observed in the case of Folidol, Fosferno, Paramar and Gusathion at 45 days.

High Concentration : As opposed to the statement above, at 10 days, all the treatments, except Gusathion, Basudin and Control, exhibited significant similarity in effectiveness. The effectiveness of Gusathion was increasingly evident at 20 days and onward. At 30 and 45 days, Folidol, Gusathion, Fosferno, Paramar and Malathion remained consistently effective while Isochlorothion and Basudin were less so. As observed at the low concentration, plants treated with Basudin and Isochlorothion showed considerable rebuild of pest population from the 30th day of the observational period. In the same period, and at 45 days, pest build up was negligible in the case of Paramar, Gusathion, Fosferno, Folidol and Malathion.

Extended analysis of results for the two concentrations of chemicals in the first group (Table VII) indicated that low concentration of Paramar, Fosferno and Folidol was comparable to high concentration of the same, Isochlorothion and Malathion at the 10th day period. At the 20th day period, low concentration of Gusathion, Paramar, Fosferno and Folidol favourably compared with high concentration of the same, Malathion and Isochlorothion. At the 30th day period, all the aforesaid chemicals, except Isochlorothion at the high concentration, maintained similar trend in effectiveness, while at the 45th day, there was no statistically appreciable change in the pattern of effectiveness. Isochlorothion was not compared at the 45th day of the observational period since it did not come in the first group at both the concentrations.

EXPERIMENT 4.—*Trials with Systemic and Non-systemic Insecticides.*

Locality : Arcadia Estate, Shevroys.
Started : July, 1960.
Details : Treatments—10.
Replications—(Leaves) 6.
Layout : Randomized.

Materials and Methods : In this experiment, the degrees of effectiveness of the systemic and non-systemic insecticides, listed below, were compared at 0.02% and 0.04% a.c.

A. Basudin—20 E.C.
B. Paramar—50 E.C.
C. Gusathion—20 E.C.
D. Fosferno—50 E.C.
E. Ekatox—50 E.C.
F. Malathion—53 E.C.
G. Meta-iso-systox—25 E.C.
H. Ekatin—20 E.C.
I. Rogor—40 E.C.
J. Control.

NOTE : Ekatox chosen as the standard in place of Folidol. Tests with Isochlorothion discontinued from this series.

Initial counts followed by post-treatment observations—as for Expt. 3—at the periods 10 and 20 days were conducted. Extended observations at 30 and 45 days could not be undertaken due to heavy rains affecting the experimental bug population.

Analysis of Results (Table VIII)

Low Concentration : At 10 days after treatment, Paramar, Ekatin, Fosferno and Malathion were superior to the rest with no significant difference among themselves. The effectiveness of Meta-iso-systox was comparable to that of Fosferno, Malathion and there was no significant difference between the former, Rogor and Ekatox. At 20 days, Paramar, Gusathion and Fosferno,together with Ekatox and Malathion remained significantly superior to the rest. Also there was no significant difference in effectiveness between the latter four of the first group and Rogor, Ekatin and Meta-iso-systox.

High Concentration : At 10 days, Paramar, Malathion, Fosferno, Meta-iso-systox and Ekatox were significantly superior to the rest of the treatments. At 20 days, the degrees of effectiveness of Paramar, Fosferno, Ekatox, Meta-iso-systox and Gusathion were similar while Malathion was comparable only to the latter four of the aforesaid chemicals. Basudin, Rogor and Ekatin, at both the periods of observations, were inferior in efficacy.

It may be seen from the above that Paramar and Fosferno were consistently effective at both the levels of concentrations in the two periods of observations. Malathion showed similar degree of toxicity in the earlier period at both concentrations. At the high concentration Ekatox was as potent as Paramar and Fosferno while Gusathion was comparably effective at both concentrations in the latter period of observations. Meta-iso-systox was more persistent at the high concentration. Basudin, Rogor and Ekatin were less consistent.

Comparison of the data for experiments 3 and 4 showed almost similar trends of insecticidal action, wherein, among the non-systemics, Paramar and Fosferno, at both concentrations, maintained consistent superiority. The effectiveness of Gusathion was comparable to that of the above at 20 days. The systemics, in general, with the exception of Meta-iso-systox, appeared less potent.

Extended trials are anticipated in the oncoming seasons.

3. **Shot hole Borer**—*Xyleborus morstatti* Hgdn. (Coleoptera, Scolytidae).

On the basis of results obtained from the earlier exploratory trials with the systemics, Meta-iso-systox 25 E.C. and Ekatin 20 E.C., further series of field spray trials have been started at the Coffee Research Station, Balehonnur. The systemic, Rogor 40 E.C., is also included in these experiments. Information pertaining to these experiments, which are in progress, is given below.

EXPERIMENT 1—*Trials with Rogor* 40 *E.C., Meta-iso-systox* 25 *E.C. and Ekatin* 20 *E. C.*

Locality : N-Block, C.R. Station, Balehonnur.
Started : May 12, 1960.
Details : Treatments—4 (Chemicals at 0.04% a.c.)
Replications—3.
Plot size—Two plants with guard rows around.
Layout—Randomized.

Note : Treatments to be imposed bi-monthly till October-November 1960.

EXPERIMENT 2

Locality : L_1 Valley, C.R. Station, Balehonnur.
Started : May 13, 1960.
Details : Treatments—7 (Chemicals at 0.02% and 0.04% a.c.)
Replications—3
Plot size—Two plants with guard rows around.
Layout—Randomized.

NOTE : Treatments to be imposed monthly till October-November 1960.

EXPERIMENT 3

Locality : L_2 Valley, C.R. Station, Balehonnur.
Started : May 14, 1960.
Details : Treatments—4 (Chemicals at 0.02% a.c.)
Replications—3
Plot size—Two plants with guard rows around.
Layout—Randomized.

NOTE : Treatments to be imposed bi-monthly till October-November 1960.

Observations in the above experiments involve monthly recording of infestations on 50 twigs, selected at random, per plant and comparing the data of chemical treatments with those of Control.

EXPERIMENT 4—*Trials with Meta-iso-systox* 25 *E.C., Ekatin* 20 *E.C. and Gusathion* 20 *E.C.*

Locality : Maldarai Estate, South Coorg.
Started : July, 1960.
Details : Treatments—7 (Chemicals at 0.05% a.c. and 0.1% a.c.)
Replications—5.
Plot size—Two plants with guard rows around.
Layout—Randomized.

NOTE : Treatments to be imposed monthly till October-November 1960.

EXPERIMENT 5

(As above.)

NOTE : Treatments to be imposed bi-monthly till October-November 1960.

The experiments are in progress.

4. **Hairy Caterpillars**—*Eupterote* spp. (Lepidoptera, Eupterotidae).

EXPERIMENT 1—*Trials with ' Swing-Fog '.*

Locality : Bynecool Estate, Chickmagalur.

As reported earlier (Ann. Rept. 1958–59), a small scale field trial with Paramar 50 E.C. at 0.02% a.c. using SWING-FOG = Model SN-6 = was carried out on hairy caterpillar

congregations on the stems and foliage of Dadap (*Erythrina* sp.) and Neeli (*Bischoffia javanica* Blume). The insecticide was tried as fog and mist.

Methods : The insecticide was directed to selected congregations for an average duration of 10 minutes. Post-treatment observations were conducted at 4 hours on caterpillars *in situ* and again at 48 hours on caterpillars collected at random from the locus of application.

Results : Observations indicated that at 4 hours after treatment, both the categories of applications did not bring about any visible degree of inactivation among caterpillars. At 48 hours inactivation was comparatively higher in the case of mist than in fog.

Appreciable withering followed by defoliation of coffee bushes near the application site of fog was noticed and this might be attributed to the deposit of diesel used as a carrier in fogging. The output of mist, on the other hand, was not forceful enough to reach higher levels. Some practical difficulty was also experienced to handle the equipment satisfactorily among thick coffee bushes and on steep slopes.

5. **Eelworms** (Nematodes).

EXPERIMENT 1—*Trials with Nemagon, V.C.* 13 *Nemacide, Soil Amendments, Farmyard Manure and Vapam.*

Locality : Wooligooly Estate, North Coorg.

Started : October, 1958.

Details : Treatments—6.

Replications—5.

Plot size—144 sq. ft. holding 4 plants—With guard rows and trenches around.

Layout—Randomized.

The experiment was continued during this year also. Renewed applications of Nemagon and farmyard manure were made during October 1959 and January 1960 respectively. Due to phytotoxicity produced by Vapam (5½ gallons/acre), its application was not considered.

Results obtained, so far, indicated that plants in the treatments, farmyard manure and soil amendments, possessed better growth condition than the rest. Increase in predacious eelworm population was also evident in the former treatment. Further data have to be obtained before definite conclusions are drawn.

EXPERIMENT 2—*Pot Trials with Nematicides, Systemic and Non-systemic Insecticides.*

Locality : C.R. Station, Balehonnur.

Started : July, 1960.

Details : Treatments—6.

A. EN-18133 25 W.P. at 0.04% a.c.

B. Nemagon (T) at 0.04% a.c.

C. Meta-iso-systox 25 E.C. at 0.04% a.c.

D. Ekatin 20 E.C. at 0.04% a.c.
E. Malathion 53 E.C. at 0.04% a.c.
F. Control.

Replications—2 (One pot with four Arabica coffee seedlings per replication).

To assess the degree of effectiveness of the above nematicides and insecticides on coffee eelworms, a series of pot experiments has been started at the Coffee Research Station, Balehonnur.

Methods : Pots were filled with eelworm infected soil, and after an average interval of a week, soil samples at the depth 0 — 9" from three places in a pot were collected. The samples thus collected from a pot were thoroughly mixed and a representative sample (30 gms.) was taken for exhaustive eelworm examination (Initial). Arabica Coffee seedlings, 6 months old, were then transplanted into the pots. After an interval of three days—for establishment —diluted solutions of the chemicals (¼ gallon per pot) were applied to the respective pots. Alkathene sheets were provided to prevent the soil in pots getting drenched with rain.

Post-treatment observations on eelworm populations are planned to be undertaken at 15, 30, 45 and 60 days. At each of the above periods, observations on plant condition will also be recorded.

EXPERIMENT 3—*Pot trials with Non-systemic Insecticides.*

Locality : C.R. Sub-station, Chethalli.
Started : June, 1960
Details : Treatments—9.

A. Basudin 20 E.C. at 0.02% a.c.
A1. Basudin 20 E.C. at 0.04% a.c.
B. Gusathion 20 E.C. at 0.02% a.c.
B1. Gusathion 20 E.C. at 0.04% a.c.
C. Fosferno 50 E.C. at 0.02% a.c.
C1. Fosferno 50 E.C. at 0.04% a.c.
D. Paramar 50 E.C. at 0.02% a.c.
D1. Paramar 50 E.C. at 0.04% a.c.
E. Control.

Replications—3 (One pot with established Arabica Coffee per replication).

Methods : These were similar to those for Experiment 2 except that pots contained established Arabica Coffee plants. Hence, eelworm infected soil was forked into the soil contained in the pots.

EXPERIMENT 4—*Field Experiments with French Marigold—Var. Dwarf Double Willy.*

Locality : C.R. Station, Balehonnur.

Started : July, 1960.

Details : Treatmetns—2.

A. Marigold+Coffee

(8 Nos.) (4 Nos.)

B. Control (Coffee alone—4 Nos.)

Replications—6.

Plot size = $6\frac{1}{2}' \times 6\frac{1}{2}'$ surrounded by trenches.

Layout = Randomized.

Possibilities of controlling coffee eelworms through French marigold are to be evaluated in this experiment.

Methods : Initial as well as post-treatment soil sample collections for eelworm estimation are done at two depths, 0 — 9″ and 9 — 18″, from five places in each plot. Samples from similar depths from a plot are then thoroughly mixed and a representative sample of 30 gms. by weight is taken for exhaustive examination.

Initial observations were followed by transplanting one month old marigold seedlings in the concerned plots. During subsequent observations at 1 month, 2, 4, 6 and 8 months after initial, root samples of marigold and soil samples will be examined.

Depending upon the results of this experiment, additional varieties of French and African marigolds will be put to test.

C. Basic Research

(i) Laboratory and Field Studies on the Habits and Ecological Relationships of Pests of Coffee

(*a*) *Red borer—Z. coffeae* : Studies were aimed at determining the life cycle of this pest species. To this end, observations on the larvæ collected in the field and related rearing experiments in the laboratory were concurrently in progress.

Table below gives the head widths of various groups of larvæ collected at different periods in the field (July 1958—June 1960).

Head widths of Red borer larvæ collected for the periods, July 1958–June 1959 and July 1959 to June 1960

Season	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
					(in mm.)							
1958—1959 ...	3.0	3.0	4.3	3.5	4.0	3.0	2.5	3.0	4.0	4.0	3.5	4.0
... ...	2.0	2.3	3.0	3.0	3.5	...	2.0	2.75	3.75	3.0	3.0	3.0
		1.5	2.0	2.5	2.75	...	...	2.25	3.5	2.75	2.75	2.75
		1.3	...	2.0	...	...	...	1.75	3.3	2.5	2.5	2.5
	...	...	...	...	...	...	...	1.5	3.0	2.3	2.25	2.0
	...	...	...	...	...	...	...	1.2	2.75	2.2	2.0	1.5
	...	...	...	...	...	...	...	1.0	2.5	2.0	1.75	...
	...	...	...	...	...	...	...	...	2.3	1.0	1.5	...
	...	...	...	...	...	...	...	...	2.2	...	1.0	...
	...	...	...	...	...	...	...	...	2.0	...	...	...
	...	...	...	...	...	...	...	...	1.5	...	...	...
	...	...	...	...	...	...	...	...	0.75	...	...	...
	...	...	...	...	...	...	...	...	0.33	...	...	...
1959—1960 ...	3.5	3.0	3.2	3.5	2.5	1.5	1.75	...	3.0	3.0	2.5	2.5
...	3.0	2.5	3.0	3.2	...	...	1.0	...	2.5	2.5	2.25	0.8
	2.75	2.0	2.75	3.0	...	...	0.75	...	2.25	2.0	2.0	0.6
	2.5	1.5	2.5	2.25	...	...	...	...	2.0	1.75	1.5	...
	...	1.3	2.0	2.0	...	...	...	...	1.5	1.5	1.25	...
	...	1.0	1.5	...	...	...	...	...	1.25	1.0	1.0	...
	...	0.75	1.25	...	...	...	...	...	1.0	0.75	...	...
	...	...	...	...	...	...	...	...	0.75	...	...	...
	...	...	...	...	...	...	...	...	0.5	...	...	...

Considering the head measurements, it appears so far that there would be two principal periods of moth emergence, *viz.*, March-May and September-November. Presence of pupae and subsequent emergence of adults, in the field, substantiate emergence in the former period. However, in the latter period, neither pupae nor adults could be traced. To ascertain and confirm the existence of the latter emergence period, it is proposed to cage those plants in the field, from August-November 1960, containing advance-stage larvæ as evidenced by the size of the ejected excretory pellets.

Attempts have also been made to culture the stages in the laboratory and study their habits and duration. A brief account of these preliminary studies is given as follows :

The larva primarily tunnels through the medullary region of the stem and branches. During this process, excretory pellets are thrown out through exit holes made at convenient places on the infested part of the plant. The exit hole is partially closed by a thin flexible matrix comprising gnawed wood particles and silk. This matrix acts as a ' valve ' and is generally visible near the inner margin of the exit hole. While traversing up and down the tunnel, lengthwise of the stem or branches, the larva also gnaws lateral tunnels for short distances till the cortical cambium or bark region is reached. At this point, further boring is discontinued unless a fresh exit hole is desired to be made. In the main stem and thick primaries, the larva may also make an almost circular tunnel next to the bark. In such cases, the effects of infestation on the host plant are very pronounced and the affected parts can easily be snapped away.

To and fro movements of the larva within the tunnel are accomplished thus. The head is retracted into the first thoracic segment and the anterior region flexed as well as directed caudad. The flexed region is kept apposed to the larval body beneath. The rest of the body is then gradually drawn toward the flexure and in due course the larva faces the opposite direction.

Pupation takes place near to the last of the exit holes made by the larva. Final moult takes place within the cocoon which is made up of gnawed wood and silk. Posterior to the cocoon, the tunnel is packed with excreta for some distance. The pupal stage lasts for a period of 10—15 days. In the laboratory, unmated moth begins egg laying on the day of emergence and the maximum number of eggs laid average 500 in a lifetime. The longevity of the adult ranges from 6—9 days.

(*b*) *Leaf skeletonizer Pericallia sp.? :* Studies were commenced on eggs collected in the field. These were shiny white and approximately 1 mm. in diameter. All the eggs hatched after an incubation period of 5 days from the date of collection. The caterpillars that emerged fed on coffee and dadap leaves, preference being shown toward the intervenal areas. The veins were left intact. Most of the larvæ under observation, except two cases, underwent seven moults while the latter two had eight moults. The length of the larvæ, during the stage, increased from 0.4 cm. to 5 cm. Gradual colour changes also occurred with each moult. The first instar larvæ possessed body hairs grey in colour while the final instar larvæ bore black hairs tipped white, dorsally, and brown hairs with white tips, ventrally and laterally.

About 24 hours before each moult, the larvæ remained quiet and ceased feeding. A quiescent stage lasting about 24—48 hours preceded pupation, the latter taking place within a cocoon made up of silk and larval body hairs. The larval stage lasted for an average of 36.95 days with a range of 28—44 days.

The pupae were blackish brown, 2.4 cm. long × 1 cm. broad. This stage required an average of 19.46 days ranging from 18—20 days. The adults were about 2.0 — 2.5 cm. long with a wing expanse of 6—7cm. approximately. The forewings, thorax and head were dark grey in colour mottled with black patches. The hind wings were dark yellow to red with black markings. The males possessed pectinate antennae and the females filamentous ones. The long and slender abdomen of the male bore seven black patches dorsally whereas the short and broad abdomen of the female bore only six. Adults had an average longevity of 8.1 days with a range of 4—12 days. The females required an average preoviposition period of 2.57 days and egg production averaged 284 per female—range 78—532.

The following Table summarises the results of observations.

Life history of the Leaf skeletonizer, *Pericallia* sp. ?

Stages	Cases	Average.			Range.
		Duration (days)	Temperature °C.	Relative Humidity	Duration (days)
Egg	30	5	25.4	72.0	...
Larva					
I Instar	30	3	26.3	76.3	...
II „	30	2	26.6	74.9	...
III „	30	3	26.8	75.3	2–4
IV „	30	3.5	27.8	74.6	3–4
V „	28	4	26.3	75.2	3–5
VI „	26	5.5	25.5	76.1	3–8
VII „	20	7.9	24.6	80.7	4–12
VIII „	1	8	24.6	80.0	...
Pupa	20	19.4	23.5	82.2	8–20
Adult	17	8.1	22.5	84.3	4–12

(ii) Studies on the Abundance and Activity of Parasites of Pests of Coffee

(*a*) *Red Borer—Z. coffeae* : A species of *Amyosoma* (Hym. Braconidae) was collected from various instars of the red borer larva. The habits and life history of this species and the effects of parasitism on the host larvæ have been studied in some detail. The following summarises the observations.

Apparently, all the host larval instars were found parasitized. The maximum number of parasite eggs found on the host body was eight and these were mostly confined to the dorsal intersegmental areas. Freshly laid eggs were semi-transparent and glistening white in colour. The egg stage averaged 1½ days in duration. There were four larval instars. The larvæ, on emergence, actively sought suitable places on the host body for attachment and feeding. In this process, preference was shown toward intersegmental folds. The larval stage averaged 12 days in duration.

Within a day of leaving the host, the larvæ began spinning cocoons at some distance from the shrivelled host body. Cocoons were often found grouped together in the tunnel to resemble a honeycomb. Sites of high humidity were preferred for pupation. The pupæ, to begin with, appeared shiny white in colour. Gradually, pigmentation and related changes

of the body took place. At the end of the pupal stage, which lasted 11 days on an average, adult parasites emerged through an irregular hole gnawed on the cocoon. The process of emergence consumed 1½—2 hours. Longevity of the adults averaged 3 days in the laboratory.

The effects of parasitism on host, were manifested in terms of paralysis, and extreme flexibility of the body resulting in death.

Detailed studies have been programmed.

In the course of culturing red borer larvæ in the laboratory, many of them developed symptoms of fungus infection. The activity of the fungus, *Beauveria bassiana* (Bals.), which appeared as a white fluffy growth on the larval body, was quite perceptible from March onward ; the highest degree of incidence being recorded during March-May. Possibilities of culturing and disseminating the fungus species are to be explored since this appears to offer scope for biological control of the pest species.

(*b*) *Green bug—C. viridis* : Of the parasite species collected, *Coccophagus bogoriensis* Koening. (Hym. Eulophidae) was abundant. Among the several other species, was another eulophid, *Coccophagus lycimnia* (Walk.).

(*c*) *Shoot mealy bug* : *Leptomastix* sp. (Hym. Encyrtidae) was recorded.

(*d*) *Hairy caterpillars—Eupterote spp.* : *Apanteles* spp. (Hym. Braconidae) were abundant. *Carcelia* sp. (Dip. Tachinidae) was recorded on *Eupterote canaraica* Moore obtained from Merthikhan estate, Chickmagalur District. The activity of the parasitic fungus, *Beauveria bassiana*, was perceptible in December through January.

(*e*) *Dadap borer—Terastia meticulosalis G.* (Lep. Pyralidae) : Several braconids (*Apanteles* spp.) were obtained.

(iii) **Collection, Identification and Preservation of Insects obtained from various sources**

Insect specimens collected from light traps instituted in J and NMS V blocks at the Coffee Research Station, Balehonnur, were preserved and many of them were identified up to families. A 100-Watt electric bulb burning above a basin of water treated with kerosene, constituted the trap at J Block. The trap at NMS V Block was of a permanent nature consisting of a 6′ high tripod stand bearing two funnels at adjustable positions. An electric bulb of 100-Watt capacity burned within the top funnel and the tail end of the bottom funnel was fitted into a killing bottle containing ethyl acetate on plaster of Paris. The height of the funnels from the ground and the distance between them were adjustable by means of screws fitted into holes at 1″—intervals on the tripod stand.

With this trap, series of observations at different heights and funnel distances were being conducted. Preliminary analysis of the data indicated that the catches of insects vary in quantity and kind depending upon the height and funnel distances. In general, a distance of 8″ between funnels was found to provide good number of insects at various heights of light source in good weather. Rainy and windy weather affected collections to a great extent. Further observations are in progress. The following Table gives a comparative statement of

insect collections (total number) from the aforesaid traps for the period 24th March 1959 to 31st March 1960.

Insects collected from light traps at C.R. Station

Order.	J. Block	NMS V
Orthoptera	1059	170
Dermaptera	115	57
Hem. Homoptera	6670	1863
Hem. Heteroptera	1282	1828
Coleoptera	2889	3734
Lepidoptera	8584	1237
Hymenoptera	6629	3774
Diptera	7697	5051
Trichoptera	313	422
Isoptera	708	...
Odonata	8	3
Plecoptera	19	2
Neuroptera	87	85
Ephemeroptera	15	63
Psocoptera	12	101
Thysanoptera	...	3
Anoplura	...	1
Collembola	...	9

(iv) **Studies on Eelworms**

The species of eelworms detected and identified earlier (Ann. Rept. 1957–58 and 1958–59) were located in many more coffee estates as tabulated below.

Distribution of species of parasitic eelworms in coffee estates

Eelworms	*Radopholus similis*	*Tylenchorhynchus sp.*	*Xiphinema indicum*	*Pratylenchus sp.*	Other forms
Estates					
1. New Hope, Nilgiris ...	Yes?	Nil	Nil	Nil	Yes
2. Honeyrock, Shevaroys ...	Nil	Yes	Yes	Nil	Yes
3. Balur (Javali), Mudigere ...	Nil	Nil	Yes sp.?	Nil	Yes*
4. Madapur—B, North Coorg	Yes?	Yes	Nil	Nil	Yes*
5. Attikhan, Biligiris ...	...	Parasites present	...	...	Yes
6. Neranki, Mudigere ...	Nil	Yes?	Nil	Nil	Yes
7. Alageswara, Koppa ...	...	Parasites present	...	...	Yes
8. Balmane, South Coorg ...	...	do.	...	...	Yes
9. Coovercolly, Dibidi Division, North Coorg ...	Nil	Yes?	Nil	Nil	Yes
10. Cottabetta, Nallagottay, No. 23, South Coorg ...	...	Parasites present	...	...	Yes
11. Tabore, Shevaroys ...		do.	...	...	Yes
12. Fairglen, Shevaroys ...		do.	...	...	Yes
13. Madapur II, North Coorg	Nil	Nil	Yes sp. ?	Nil	Yes*
14. Ampalkot Garden, Gudlur, Nilgiris ...	Nil	Yes	Nil	Nil	Yes
15. Kerkiconda, Koppa ...	Nil	Yes?	Nil	Nil	Yes
16. Ranjitha Plantations, Nellakotta, Nilgiris ...	Nil	Yes	Nil	Nil	Yes
17. Kurukanmatti, Chickmagalur	...	Parasites present	...	...	Yes
18. Tottlukhan, Chickmagalur	...	do.	...	...	Yes
19. Canoncadoo, North Coorg	Yes?	Yes?	Nil	Nil	Yes
20. Manjnatha, Aldur ...	...	Parasites present	...	...	Yes
21. Merthikhan, Koppa ...	Yes?	Nil	Nil	Nil	Yes
22. Cullaley–Cowcody Gr., North Coorg ...	...	Parasites present	...	...	Yes
23. Nirmala, Nilgiris ...	Yes?	Nil	Nil	Nil	Yes
24. St. Mary's, Pulneys ...	Nil	Yes?	Nil	Nil	Yes
25. Coffee Research Station, Balehonnur ...	Nil	Yes	Nil	Nil	Yes**
26. Lauriston, Nilgiris ...	...	Parasites present	...	...	Yes

* *Rotylenchulus* sp., *Helicotylenchus* sp.

** *Rotylenchulus* sp. *Helicotyenchus nannus*, *H. erythrinae*, *Xiphinema sp.*, X. *americanum*, *Hoplolaimus* sp. etc.

Total number of samples examined 825

Of the above estates, Balur, Madapur-B, Balmane and Coovercolly exhibited very high parasitic population.

In the course of observations, it was seen that the population of parasites in soil was easily detectable on the advent of blossom showers and the level reached a peak by June. In July, a decrease in population became evident which appeared to be correlated with the high moisture content of the soil layers. Presumably, in the monsoon season, parasites and non-parasites are distributed by the flow of water within the soil layers and that the degree and time of decrease or increase in population are related, among other factors, to the type of soil as well as the amount of and time taken for saturation.

Further studies to examine these factors to analyse the effect of temperature and moisture on the parasite species are envisaged.

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TABLE I

Incidence of shot hole borer—*X. morstatti*—at the Coffee Research Station

1958–59 *and* 1959–60 (*August–July comparative*)*

Season.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1958–59 ...	107	128	136	169	192	150	94	34	13	12	10	12
Percent ...	7.13	8.53	9.06	11.26	12.8	10.0	6.26	2.27	0.86	0.8	0.66	0.8
1959–60 ...	14	25	55	75	88	112	131	69	63	52	108	121
Percent ...	0.93	1.66	3.66	5.0	5.86	7.46	8.73	4.60	4.2	3.46	7.2	8.06

* Infested twigs in 1500 twigs examined per month.

TABLE II

Incidence of Red Borer—*Z. coffeae*—in the selected blocks and in the rest of the estate at the Coffee Research Station

(*July* 1959 *to June* 1960)

Blocks	Area in acres	1959						1960						Total	Per acre
		July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June		
N M S IV ...	0.82	0	0	0	1	0	0	0	0	2	1	0	0	4	5
N M S V ...	2.06	0	2	1	1	0	0	0	2	30	3	3	1	43	22
L2 Seed ...	5.25	1	1	2	2	4	0	2	1	12	5	5	3	38	7
1955 Seed ...	4.22	2	3	1	1	0	1	0	2	7	4	1	2	24	5
J	2.24	0	0	0	0	0	0	0	0	2	2	2	0	6	3
Total ...	14.59	3	6	4	5	4	1	2	5	53	15	11	6	115	8 (approx.)
Rest of the estate ...	83.68	5	8	14	12	4	not traced	5 (Casual)	11 (only young area traced)	35	34	12	7	147	...
Grand total ...	98.27	8	14	18	17	8	1	7	16	88	49	23	13	262	3 (approx.)

TABLE III

Incidence of White Stem Borer—*X. quadripes*—In Various Experiments

Treatments		Mean percentage infestation of White stem borer		
		Perembo-cooly Estate (North Coorg)	Godhanda Estate (Mudigere)	Belagode Estate (Saklespur)
A. B.H.C. 50% W.P. (Twice a year)	...	3.69	13.20	46.80
B. B.H.C. 50% W.P. (Thrice a year)	...	1.84	15.97	42.10
C. Control—No treatment	...	5.55	25.67	51.00
D. Dieldrin 50% W.P.	...	2.77	18.40	27.26
E. Heptachlor 25% W.P.	...	3.23	18.02	44.44
F. Gusathion 20% E.C.	...	2.77	14.90	52.43
General Mean	...	3.30	17.69	44.00
S.E.M.	...	0.313	1.17	...
Critical Difference	...	0.984	3.52	...
Significance	...	Yes*	Yes*	No
Conclusion	...	BDFEAC	AFBEDC	...

TABLE IV

Effect of systemic and non-systemic insecticides on the green bug—*C. viridis*—(Laboratory)

Treatment	Mean percentage mortalities obtained at					
	Low Concentration (0.01% a.c.)			High Concentration (0.02% a.c.)		
	36 hours after treat.	72 hours after treat.	96 hours after treat.	36 hours after treat.	72 hours after treat.	96 hours after treat.
A. Basudin 20 E.C.	7.90	14.82	27.40	50.05	69.20	77.52
B. Gusathion 20 E.C.	19.25	34.77	50.95	19.30	51.72	67.82
C. Paramar 50 E.C.	10.80	39.62	64.97	37.37	59.37	80.50
D. Fosferno 50 E.C.	22.32	34.12	61.67	34.60	62.72	71.52
E. Isochlorothion 50 E.C. ...	16.20	30.52	52.37	15.52	44.27	55.60
F. Folidol 46. 7 E.C.	46.00	73.80	80.20	46.77	66.72	85.82
G. Rogor 40 E.C. ...	12.06	39.57	56.05	18.32	32.67	51.00
H. Ekatin 20 E.C. ...	11.72	22.80	25.82	33.40	39.25	50.20
I. Meta-iso-systox 25 E.C. ...	22.75	42.32	53.72	37.70	49.85	60.75
J. Malathion 53 E.C.	21.32	48.10	74.15	40.82	45.55	61.37
K. Control	0	0	0	0	0	0
General Mean ...	...	34.58	49.74	29.12	47.39	60.21
S.E.M. ...	...	4.12	3.18	4.27	3.91	3.15
Critical Difference.	...	11.90	9.18	12.32	11.28	9.09
Significance ...	No	Yes**	Yes**	Yes**	Yes**	Yes**
Conclusion ...	...	FJICGBDEHAK	FJCDGIEBAHK	AFJICDHBGEK	AFDCBIJEHGK	FCADBJIEGHK

TABLE V

Effect of Systemic Insecticides on the Green Bug—*C. viridis* (Gavikhan Expt.)

	Treatments	Mean percentage reductions obtained at				
		15 days after treat.	25 days after treat.	35 days after treat.	45 days after treat.	55 days after treat.
	Series I (0.01% *a.c.*)					
A.	Rogor 40 E.C.	79.67	72.47	42.60	...	...
B.	Control	...	...	...	...	...
C.	Meta-iso-systox 25 E.C. ...	73.05	64.85	48.52	...	...
D.	Ekatin 20 E.C.	38.00	52.67	49.92	...	
	General Mean	47.68	47.49	35.76	...	...
	S.E.M.	3.905	6.01	7.154	...	...
	Critical Difference	12.48	19.22	22.88	...	...
	Significance	Yes**	Yes**	Yes**	...	...
	Conclusion	A C D B	A C D B	D C A B	...	...
	Series II (0.02% *a.c.*)					
A.	Rogor 40 E.C.	83.21	84.24	68.82	81.56	...
B.	Meta-iso-systox 25 E.C. ...	83.24	92.40	82.96	87.28	...
C.	Control	...	...	...	...	...
D.	Ekatin 20 E.C.	21.18	35.70	57.34	33.76	...
	General Mean	46.05	53.08	52.28	50.65	...
	S.E.M.	3.116	2.172	4.089	2.814	...
	Critical Difference	9.5	6.65	12.54	8.63	...
	Significance	Yes**	Yes**	Yes**	Yes**	...
	Conclusion	B A D C	B A D C	B A D C	B A D C	...

TABLE V—(*contd.*)

Effect of Systemic Insecticides on the Green Bug—*C. viridis* (Gavikhan Expt.)—(*contd.*)

	Treatments	Mean percentage reductions obtained at				
		15 days after treat.	25 days after treat.	35 days after treat.	45 days after treat.	55 days after treat.
	Series III (0.04% *a.c.*)					
A.	Rogor 40 E.C.	87.44	98.32	90.78	...	97.02
B.	Meta-iso-systox 25 E.C. ...	76.70	98.52	95.68	...	79.84
C.	Control	...	...	...	...	...
D.	Ekatin 20 E.C.	28.10	55.78	21.60	...	4.86
	General Mean	48.06	63.15	52.01	...	45.43
	S.E.M.	2.116	3.237	3.033	...	3.538
	Critical Difference	6.49	9.93	9.3	...	10.85
	Significance	Yes**	Yes**	Yes**	...	Yes**
	Conclusion	A B D C	B A D C	B A D C	...	A B D C

TABLE VI

Effect of non-systemic insecticides on the green bug—*C. viridis*—(Maruvahalla Experiment)

Treatments	Mean percentage reductions obtained at							
	Low Concentration (0.02% a.c.)				High Concentration (0.04% a.c.)			
	10 days after treatment	20 days after treatment	30 days after treatment	45 days after treatment	10 days after treatment	20 days after treatment	30 days after treatment	45 days after treatment
A. Basudin 20 E.C. ...	58.10	49.43	41.18	36.15	77.11	85.48	60.45	57.71
B. Paramar 50 E.C. ...	95.08	99.18	99.41	98.52	96.98	98.91	99.95	99.18
C. Gusathion 20 E.C. ...	81.40	97.90	99.78	97.81	86.91	99.60	99.85	100.00
D. Fosferno 50 E.C. ...	92.60	99.64	99.68	98.91	97.15	99.75	99.98	99.43
E. Isochlorothion 50 E.C. ...	78.15	77.51	66.56	59.73	95.80	98.23	95.63	92.11
F. Folidol 46.7 E.C. ...	92.55	99.76	99.66	99.05	93.81	99.90	100.00	98.46
G. Malathion 53 E.C. ...	72.96	74.86	68.01	57.98	95.58	99.13	99.76	98.38
H. Control	0	0	0	0	0	0	0	0
General Mean ...	71.35	77.28	75.53	68.51	80.41	85.23	70.70	81.25
S.E.M.	1.67	1.607	2.51	2.516	3.27	0.76	2.38	2.2
Critical Difference ...	4.62	4.45	6.86	6.968	9.05	3.8	6.607	6.3
Significance ...	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**	Yes**
Conclusion	BDFCEGAH	FDBCEGAH	CDFBGEAH	FDBCEGAH	DBEGFCAH	FBDCGEAH	FDBCGEAH	CDBFGEAH

TABLE VII

Comparative effectiveness of low and high concentrations of chemicals in the first group (Table VI) at similar periods (Maruvahalla Experiment)

	Treatments	Mean percentage reductions obtained at			
		10 days low conc. *vs.* 10 days high conc.	20 days low conc. *vs.* 20 days high conc.	30 days low conc. *vs.* 30 days high conc.	45 days low conc. *vs.* 45 days high conc.
	Low Concentration				
1.	B Paramar	95.08	99.18	99.41	98.53
2.	D Fosferno ...	92.60	99.64	99.68	98.91
3.	F Folidol	92.55	99.76	99.66	99.05
4.	C Gusathion	...	97.90	99.78	97.81
	High Concentration				
5.	B Paramar	96.98	99.81	99.95	99.18
6.	D Fosferno	97.15	99.75	99.98	99.43
7.	E Isochlorothion	95.80	98.23	95.63	...
8.	F Folidol	93.81	99.90	100.00	98.46
9.	G Malathion	95.58	99.13	99.76	98.38
10.	C Gusathion	...	99.60	99.85	100.00
11.	H Control	0	0	0	0
	General Mean	84.39	90.26	90.33	88.97
	S.E.M.	1.848	0.72	0.781	1.18
	Critical Difference	5.28	2.04	2.23	3.26
	Significance	Yes**	Yes**	Yes**	Yes**
	Conclusion	65791823 $\overline{11}$	85362101974 $\overline{11}$	86510492317 $\overline{11}$	106532184 $\overline{11}$

TABLE VIII

Effect of systemic and non-systemic insecticides on the green bug—*C. viridis* (Arcadia Experiment)

	Treatments	Mean percentage reductions obtained at			
		Low Concentration (0.02% a.c.)		High Concentration (0.04% a.c.)	
		10 days after treatment	20 days after treatment	10 days after treatment	20 days after treatment
A.	Basudin 20 E.C.	67.25	85.25	76.75	84.80
B.	Paramar 50 E.C.	94.35	98.93	93.78	99.56
C.	Gusathion 20 E.C.	81.10	96.11	76.42	96.18
D.	Fosferno 50 E.C.	91.15	95.42	90.33	98.61
E.	Ekatox 50 E.C.	86.71	95.10	88.83	98.18
F.	Malathion 53 E.C.	90.95	93.58	92.47	94.53
G.	Meta-iso-systox 25 E.C. ...	89.15	88.93	89.11	96.51
H.	Ekatin 20 E.C.	92.83	89.88	69.97	61.76
I.	Rogor 40 E.C.	86.80	90.75	70.37	75.56
J.	Control	0	0	0	0
	General Mean	78.029	83.39	74.80	80.569
	S.E.M.	1.31	2.86	2.19	1.707
	Critical Difference	3.62	7.92	6.06	4.72
	Significance	Yes**	Yes**	Yes**	Yes**
		BHDFGIECAJ	BCDEFIHGAJ	BFDGEACIHJ	BDEGCFAIHJ

V. MYCOLOGY

Studies initiated earlier on the fundamental and applied aspects of the various diseases affecting coffee were pursued. The main items of work undertaken during the period were—

(1) Chemical control of leaf rust disease of coffee through the use of different fungicidal formulations as well as methods and timings of their applications,

(2) Studies on ' Berry Blotch ' disease,

(3) Studies on nursery and post-nursery diseases,

(4) New records and

(5) Investigations on ' Die-back ' complex : a new malady which has assumed considerable importance of late.

I. Studies on Leaf Rust Disease of Coffee caused by Hemileia vastatrix B & Br.

A. Disease control through fungicidal sprays.

(a) Comparison of proprietary fungicides with Bordeaux Mixture.

(1) Field trials at Coffee Research Station, Balehonnur.

Trial 1 : The field trial started during May 1957 using Cobredon, Cupricol, Dithane-M22 and Bordeaux Mixture was continued. Spray applications with the different formulations were given at scheduled periods. Observations on the effective percentage of leaf survival recorded in the plots receiving the different treatments are summarised in *Table MY*-I.

During September 1959, Treatment D (Bordeaux Mixture) was found to be significantly superior to Treatments E and B (unsprayed control and Cupricol respectively), but was on par with Treatments C and A (Dithane-M22 and Cobredon respectively). In February 1960 observation, Treatment D (Bordeaux Mixture) was significantly superior to all the other treatments. Out of six observations on effective percentage of leaf survival recorded from start of trial, it is noticed that in five cases, Bordeaux Mixture treatment is significantly superior to all or some of the proprietary formulations tested. However, in February 1958 observation, Dithane—M22 treatment is found to be superior to Bordeaux. The trial is concluded and discontinued.

Trial 2 : This trial started during 1959 pre-monsoon period to compare eradicant fungicide 0-3818B with Bordeaux Mixture was continued. Observations recorded are summarised in *Table MY*-II.

In both September 1959 and February 1960 observations, treatment differences though statistically not significant, however, numerically Bordeaux treated plots showed better leaf retention. In plots sprayed with the eradicant fungicide, phyto-toxic symptoms were observed about three weeks after the first round of spray, scorching of leaves followed by shed was

observed. However, subsequent rounds of spray did not show any noticeable phyto-toxicity. The experiment is being continued.

Trial 3 : During September 1959, an exploratory row trial was started to test the efficacy of an eradicant fungicide—" Cyprex-65 W " in controlling leaf disease as compared to standard 0.5% Bordeaux Mixture. The details are given below :

Locality : Coffee Research Station, Balehonnur.

Year of Start : September 1959.

Treatments :

(A)	Cyprex—65 W	... 0.3%	4 rounds of spray per year.
(B)	Do.	... 0.2%	
(C)	Do.	... 0.1%	
(D)	Bordeaux Mixture	... 0.5%	2 rounds of spray per year.

Layout : Simple row trial.

Plot size

Gross ... 3 rows of 16 plants.
Nett ... Middle row of 14 plants.

The observations recorded during February 1960 did not show any appreciable difference in leaf retention between the treatments. It was observed that in the case of plants treated with different concentrations of Cyprex-65 W, a certain amount of premature leaf fall was noticed about two to three weeks after the first round of spraying ; however, subsequent rounds of spray did not cause any further considerable defoliation. The trial is being continued.

Trial 4 : A spray trial was started during March 1960 to study the effect of alternating applications of eradicant fungicides with protectant Bordeaux in the control of leaf disease of coffee. The details of the trial are as follows :—

Locality : Coffee Research Station, Balehonnur.

Year of Start : March 1960.

Treatments :

(A)	Bordeaux 0.5%	... 4 rounds of spray per year.
	1st spray	... March (before blossom showers).
	2nd spray	... Middle of May (6 weeks after blossom showers).
	3rd spray	... Middle of September (between South-West and North-East Monsoon).
	4th spray	... End of November (close of North-East Monsoon).
(B)	Flit—407 0.4% (Timings as above.)	... 4 rounds of spray per year.

(C) Cyprex—65 W 0.3% ... 4 rounds of spray per year.
(Timings as in Treatment A.)

(D) Eradicant fungicide 0-3818B—0.35% ... 4 rounds of spray.
(Timings as in Treatment A.)

(E) Flit—407 and Bordeaux ... 4 rounds of spray.
1st spray with Flit—407 0.4% ... March.
2nd spray with Bordeaux—0.5% ... May.
3rd spray with Bordeaux—0.5% ... September.
4th spray with Bordeaux—0.5% ... November.

(F) Cyprex—65 W and Bordeaux ... 4 sprays per year.
(Timings as in Treatment E, substituting Cyprex—65 W for Flit—407.)

(G) Eradicant fungicide 0-3818B and Bordeaux ... 4 rounds of spray.
(Timings as in Treatment E.)

(H) Bordeaux 0.5% ... 2 rounds of spray per year.

(I) Bordeaux and Flit—407 ... 3 rounds of spray per year.
1st spray with Bordeaux 0.5% ... April-May.
2nd spray with Bordeaux 0.5% ... September-October.
3rd spray with Flit—407 0.4% ... December-January.

(J) Bordeaux and Cyprex-65W ... 3 sprays per year.
(Timings as in Treatment I.)

(K) Bordeaux and Eradicant fungicide 0-3818B ... 3 sprays per year.
(Timings as in Treatment I.)

(L) Bordeaux 0.5% ... 3 sprays per year
(Timings as Treatment I).

(M) Bordeaux 0.5% ... 3 sprays per year.
1st spray ... April-May.
2nd spray ... August-September.
3rd spray ... November-Middle.

Layout : Simple row trial.

Plot size : Gross : 3 rows of 10 plants.
Nett : Middle row of 5 plants.

Results are awaited.

(2) Field trials at Coffee Research Sub-Station, Chethalli—

Trial 5 : This trial started during May 1957 using Flit—406, Bordeaux Mixture and Kirticopper with and without addition of Tenac sticker was continued. Spray applications with the different formulations were given according to schedule. The observations on leaf retention recorded are summarised in *Table MY-III.*

In both September 1959 and February 1960 observations, treatment differences are found to be not significant.

Trial 6 : This trial using Cobredon, Cupricol, Parrycop, Dithane-M22 and Bordeaux Mixture with and without addition of Tenac sticker started during May 1958 was continued. Observations on leaf retention recorded are summarised in *Table MY-IV.*

Both in September 1959 and February 1960 observations, no significant differences are noticed between treatments ; however, in both observations, Bordeaux Mixture either alone or with sticker has given numerically better leaf retention as compared to the other fungicides under test.

(3) Field trials in different Liaison zones under the Proprietary Products Testing Scheme :—

Trial 7 : This trial started in Woodlands Estate, Coonoor, during 1958 post-monsoon period comparing Cupricol, Kirticopper and Microcop with Bordeaux Mixture was continued. Spray applications were given according to schedule. Observations on effective percentage of leaf survival and yield data are furnished in *Table MY-V.*

No significant differences between treatments are noticed in leaf retention and yield of ripe cherry. The trial is being continued.

Trial 8 : This trial started in Pillavali Estate, Pulneys, during 1958 post-monsoon period comparing Cobredon with Bordeaux Mixture, with and without addition of sticker was continued. The results of observations recorded are summarised in *Table MY-VI.*

No significant differences between treatments are noticed in leaf retention and yield of ripe cherry. However, in all the three observations, Bordeaux treatment showed better leaf retention. The trial is being continued.

Trial 9 : This trial started in Bonaventura Estate, Yercaud, during 1958 post-monsoon period comparing Flit—406 and Parrycop with Bordeaux Mixture was continued. Results of observations recorded are summarised in *Table MY-VII.*

No significant differences are noticed between treatments with regard to leaf retention and yield of ripe cherry. However, in two out of three observations on leaf retention and in 1959–60 yield, Bordeaux treated plots gave numerically better results. The trial is being continued.

Trial 10 : This trial started in Coffee Research Sub-Station, Chethalli, Coorg, during 1958 post-monsoon period, comparing Microcop and Ultra-sulphur with Bordeaux Mixture was continued. Observations on leaf retention recorded in plots receiving the different treatments are summarised in *Table MY-VIII.*

In September 1959 observation, Bordeaux treatment has given significantly superior leaf retention over the other treatments, whereas in February 1959 and February 1960 leaf counts, though no significant differences between treatments were noticed, Bordeaux treatment gave numerically better results.

Trial 11 : This trial started in Cheekanahally Estate, Belur Taluk, during 1959 pre-monsoon period, using Flit–406, Cupricol and Bordeaux Mixture (with and without addition of Tenac sticker) was continued. Results of observations recorded are furnished in *Table MY-IX.*

The differences between treatments with regard to leaf retention are not significant. The trial is being continued.

Trial 12 : This trial started in Vasantacool Estate, Chickmagalur, during 1959 pre-monsoon, comparing Parrycop, Cobredon and Kirticopper with Bordeaux Mixture was continued. Results of observations recorded are furnished in *Table MY-X.*

No significant differences between treatments in the matter of leaf retention are observed. The trial is being continued.

General conclusions on spray trials comparing proprietary fungicides with Bordeaux Mixture for controlling leaf disease of coffee : The relative efficacy of twelve different proprietary formulations (fungicides and stickers) based on copper, sulphur and of an organic nature, in one or more concentrations have been compared with standard 0.5% Bordeaux Mixture with regard to control of leaf rust disease of coffee. In the majority of cases, treatment differences were found to be non-significant ; but however, where significant differences were observed, Bordeaux Mixture was found to be significantly superior over some or all of the proprietary formulations tested. Similar trends were observed in previous years observations also.

(*b*) *Time of spray trial in North-East Monsoon rainfall areas :* The trial started during 1957 pre-monsoon period in the Shevaroys, to find out a suitable time schedule for protective spraying against leaf disease was continued. The data recorded is furnished in *Table MY-XI.*

Out of the five observations recorded on leaf retention only in February 1959 observation, Treatment A (3 sprays) was significantly superior to the rest of the treatments and in the other four observations it was on par with two and one spray treatments. All the spray treatments have shown consistently superior leaf retention over the unsprayed control. In the two observations on yield of ripe cherry recorded, during 1958–59, all the sprayed plots are significantly superior to unsprayed control and during 1959–60, no significant differences are noticed. The trial is concluded and discontinued.

(*c*) *Spraying of leaf disease resistant Station Selections :* The trials started during the pre-monsoon period of 1959 to find out the possible beneficial effects to be derived through spraying of leaf disease resistant selections were continued.

Trial 1. *Bulk observational trial at Kerkiconda Estate, Balehonnur :* Spraying with different concentrations of Bordeaux Mixture was taken up as per schedule. The yield recorded during 1959–60 being the basic one, no interpretations were made. The trial is being continued,

Trial 2. Critical trial at Coffee Research Sub-Station, Chethalli : Observations on comparative leaf retention and yield data recorded in the different treatments are summarised in *Table MY-XII.*

In February 1960 observation on leaf retention, Treatment C (Bordeaux 2%) is significantly superior to the other treatments and Treatment B (Bordeaux 1%) is significantly superior to Treatment A (Bordeaux 0.5%), Treatment D (Flit—406) and Treatment E (unsprayed control). All sprayed treatments are superior to unsprayed control. During September 1959 observation, no significant differences between treatments are observed. The yield data being the basic one, no statistical analysis and interpretations have been made. The trial is being continued.

(*d*) *Spraying upper surface of leaves* vs. *Spraying under surface :* This trial started during 1959 pre-monsoon period, to find out whether spraying the upper surface of leaves alone would give adequate protection from leaf disease comparable to that afforded by the normal under surface spray, was continued. The observations recorded on leaf retention and the yield of ripe cherry in the plots receiving different treatments are summarised in *Table MY-XIII.*

No significant differences in leaf retention are observed between treatments both in September 1959 and February 1960 leaf counts. The yield data being the basic one, statistical interpretations have not been made.

(*e*) *Low volume Spray Trials :* The possibilities of successful introduction of low volume spraying of coffee were further explored by trying out in the field, a low volume " Micronette " sprayer working on an air blast principle. It was found that though the volume of spray required per unit area was considerably low as compared to that required by the present standard high volume high pressure spray equipment, the following disadvantages were met with in using this low volume equipment.

(1) Coverage was poor, particularly in thickly covered coffee.

(2) Many practical working difficulties like, impediment to free movement in the coffee rows, strain on the mazdoors carrying the machine due to heavy vibration, etc. were observed.

(3) The time required to cover a unit area was considerably more than while working with the high volume equipment, this in turn resulting in extension of spraying period unless many spray units are employed simultaneously.

(*f*) *Frequency of spraying :* With the considerable change in coffee cultivation practices (opening up of overhead shade and frequent and liberal artificial fertilizing) that has taken place in South Indian Coffee in recent years, it has been observed that the growth of new flush is extended over a fairly long period. To afford protection from leaf disease on this more or less continuously growing flush, the present common practice of two rounds of spray often appear to be inadequate. In order to find out an optimum economic number of rounds of spray needed to afford reasonable protection from leaf disease and to fix their timings, a spray trial has been started during 1960 pre-monsoon period. In this trial, the effect of giving

a Bordeaux spray during the dry period February-March (before blossom showers) so as to reduce live disease inoculum is also being studied, as against the normal protectant sprays. The details of the trial are furnished below :—

Locality : Coffee Research Station, Balehonnur.

Year of Start : March 1960.

Treatments :

(A) Sprays at formation of every three pairs of new leaves.
(First spray : 20 days after blossom showers).

(B) Five rounds of spray per year (2 pre., 1 mid. and 2 post-monsoon).
(1) April-May.
(2) Early June (prior to start of South-West Monsoon).
(3) August-September (break in South-West Monsoon).
(4) October-November (break in North-East Monsoon).
(5) Early January.

(C) Four sprays an year (2 pre-monsoon and 2 post-monsoon).
(1) April-May.
(2) Early June.
(3) Mid-September (towards close of South-West Monsoon).
(4) End of November (towards close of North-East Monsoon).

(D) Four sprays an year. (2 pre-monsoon and two post-monsoon).
(1) March (just prior to blossom showers).
(2) Mid-May (six to eight weeks after blossom showers).
(3) Mid-September (close of South-West Monsoon).
(4) End of November (close of North-East Monsoon).

(E) Three sprays an year (1 pre., 1 mid. and 1 post-monsoon).
(1) April-May.
(2) August-September (break in South-West Monsoon).
(3) Mid-October.

(F) Three sprays an year (2 pre-monsoon and 1 post-monsoon).
(1) April-May.
(2) Early June (prior to start of South-West Monsoon).
(3) September-October.

(G) Three sprays an year (2 pre-monsoon and 1 post-monsoon).
(1) March (prior to blossom showers).
(2) Mid-May (6 to 8 weeks after blossom showers).
(3) September-October.

(H) Three sprays an year (1 pre-monsoon and 2 post-monsoon).

(1) April-May.
(2) Mid-September (close of South-West Monsoon).
(3) End of November.

(I) Two sprays (control).

(1) April-May.
(2) September-October.

Layout : Randomized. *Replications :* 4. *Treatments :* 9.

Plot size : Gross : 5 rows of 10 plants = 50 plants.
Nett : 3 rows of 8 plants = 24 plants.

Results are awaited.

B. Cytological studies on " Hemileia vastatrix " B and Br.

Fundamental studies on the cytology of *Hemileia vastatrix* have been started. From the preliminary studies so far made, an interesting phenomenon of the occurrence of bi-nucleate condition of the basidiospores (normally uninucleate basidiospores are encountered in most of the rust fungi) has been encountered. Further detailed studies are in progress.

II. Studies on " Berry Blotch " Disease

Since 1957, a disease causing dark brown shrivelled blotches on maturing coffee berrie has been noticed in many plantations, particularly from the South-West Monsoon areas. This disease has been observed to be steadily on the increase. A high disease incidence was often observed in the first round of harvest (as much as 14 to 33%), with gradual decrease in disease incidence in subsequent gatherings. The diseased tissues of the fruit skin become dry and hard and stick to the parchment cover and such fruits are difficult to pulp properly, thus lowering the quality considerably.

Microscopic examination of the affected tissues showed invariably the presence of conidiophores and conidia of *Cercospora* Sp. in profusion. On account of the fairly wide spread occurrence and the consequent damage to the crop, investigations were taken up with particular reference to factors affecting the incidence and spread as well as its control aspect through use of fungicidal formulations.

(*a*) *Studies on the influence of various factors on disease incidence :* These studies were taken up during 1959–60 season.

(1) Influence of intensity of shade

The effect of varying intensities of shade on the incidence of this disease was studied on S. 795 Arabica Coffee. The incidence of the disease under thick, light and no shade conditions recorded are furnished in *Table MY-XIV.*

Considerable difference in the percentage of disease incidence is observed under the different shade intensities studied. Disease incidence in Treatment A (thick shade) is

significantly less compared to Treatments B (light shade) and C (no shade). Also, disease incidence in light shade is significantly less compared to no shade. This would indicate that intensity of shade is a major factor determining the incidence and intensity of this disease.

(2) Varietal susceptibility

To find out whether there is any difference in degree of susceptibility exhibited by different Arabica varieties, observations on incidence of the disease were recorded on the following Arabica varieties :—

" Coorgs ", " S. 795 ", " S. 288 ", " S. 333 " and " S. 446 ".

The results of observations are summarised in *Table MY-XV*.

" Coorgs " variety showed significantly higher disease incidence over the other varieties observed. " S. 795 " showed the next highest susceptibility to disease incidence. Varieties " S. 288 ", " S. 333 " and " S. 446 " did not show any significant differences between themselves.

(3) Influence of age of the plant

Observations carried out to evaluate the influence, if any, of different age groups of the plant material with regard to susceptibility to the disease, did not reveal any appreciable difference.

(*b*) *Disease control through fungicidal sprays :* (1) Observations to assess the efficacy of 0.5% Bordeaux Mixture in checking the disease incidence were taken up on " Coorgs " and " S. 795 " Arabica varieties. The trial plots received two rounds of Bordeaux spray (1 pre-monsoon and 1 post-monsoon), the control plots being left unsprayed. The results of observations are summarised in Table MY-XVI. The sprayed plots of both " Coorgs " and " S. 795 " showed significantly less disease incidence as compared to unsprayed ones. Among the unsprayed plots, " S. 795 " showed significantly lesser disease incidence than " Coorgs " variety.

(2) The efficacy of different strengths of Bordeaux Mixture (0.5%, 1% and 2%) in checking the disease was compared with Flit-406 (0.4%) and unsprayed control. One pre-monsoon spray in May and one post-monsoon spray in September were given with the different formulations. The results of observations on comparative disease incidence recorded in the different treatments are furnished in Table MY-XVII. All the sprayed plots showed significantly lesser disease incidence than the unsprayed control. The different concentrations of Bordeaux Mixture are found to be significantly superior to Flit–406. Between the different concentrations of Bordeaux, the 2% strength is superior to 1% and 0.5% ; and 1% is superior to 0.5%.

To determine the comparative efficacy of different fungicidal formulations and their time of application for an effective economic control of the disease, further extended trials have been started during the current season. Results are awaited.

III. Studies on brown-eye-spot disease of seedlings

Comparative efficacy of different fungicides in controlling the disease : The trial using different fungicidal formulations to evaluate their efficacy in controlling the disease, started

during the previous season, was repeated for confirmation of results. Observations recorded on the comparative disease incidence in the different treatments are furnished in the following Table :—

Treatments	Percentage disease incidence						
	June 1959	July 1959	August 1959	Sep. 1959	Oct. 1959	Nov. 1959	Dec. 1959
A. Dithane M : 22. 0.4% ...	7.1	9.5	9.2	12.2	16.7	33.3	34.7
B. Flit—406. 0.4% ...	6.2	12.6	18.5	28.0	48.3	60.8	56.6
C. Bordeaux Mix. 1.0% ...	Nil	4.6	2.3	2.3	2.1	1.4	1.3
D. Eradicant fungicide 03818B 0.35% ...	7.0	13.4	28.7	42.3	68.0	78.0	81.2
E. Spersul. 0.4% ...	6.2	23.1	35.0	51.6	78.8	67.0	59.2
F. Dithane M–22. 0.4% ...	Nil	12.3	23.7	40.2	79.1	87.0	84.4
G. Flit–406 0.4% ...	11.2	19.2	37.4	44.0	87.5	94.4	92.8
H. Bordeaux Mix. 1.0% ...	Nil	10.0	9.7	10.2	12.0	8.0	7.5
I. Eradicant fungicide— 03818B. 0.35% ...	9.8	20.9	37.3	45.1	84.0	92.3	88.3
J. Unsprayed control ...	23.4	42.6	53.0	69.3	88.8	100.0	100.0

Note.—Treatments : A to E are fortnightly spray applications and F to I are monthly spray applications.

All the sprayed plots showed comparatively lesser disease incidence than unsprayed plots. Fortnightly applications of the fungicides were more efficient in controlling the disease as compared to monthly applications. Bordeaux Mixture treatment gave maximum disease control followed by Dithane–M22, and Flit–406. Similar trends were observed in last year's trial also. Eradicant fungicide 03818B was not very effective in controlling the disease ; it showed considerable phyto-toxic symptoms during the first two months of application, later subsiding slowly.

IV. Studies on "Stem-wasting"—Kondli disease of seedlings

Investigations on this malady to determine the causative agency, factors influencing its incidence and intensity, varietal susceptibility, if any, and possibilities of control initiated during early 1959 were continued.

(*a*) *Determination of causative agency : Artificial infection trials.*—Inoculations with the following organisms, *viz.*, *Chaetophoma Sp.*, *Fusarium Sp.*, Bacterial culture, *Rhizoctonia solani* and *Rhizoctonia bataticola*, carried out on healthy seedlings at monthly intervals during the period March 1959 to August 1959 did not succeed in reproducing the disease symptoms. Observations were continued till November 1959.

Trials are being repeated from March 1960 to artificially reproduce the disease symptoms on healthy seedlings by inoculating the different micro-organisms found associated with diseased

tissues of Kondli affected plants, but so far none of the artificially inoculated seedlings have developed the disease symptoms.

(*b*) *Influence of application of artificial fertilizers and Bordeaux Mixture on the incidence of the disease :* Trials started early in January 1959 using urea, ammonium sulphate, Sterameal, complete fertilizer mixture (N:P:K), Potash, Lime and Borax as compared with an unfertilized control treatment, with and without periodical applications of Bordeaux Mixture as sub-treatments were continued.

Further to the disease incidence reported in the previous season, fresh incidences were noticed in later observations continued up to November 1959. From the results of these observations, the same trends as indicated in the previous report were observed *viz.*,—

(1) In different treatments with major and minor elements of nutrition when not combined with Bordeaux Mixture sprays, the disease incidence was not observed.

(2) Plots receiving frequent application of Bordeaux Mixture showed invariably very high disease incidence.

To confirm the results obtained in the previous season, the following further elaborated trials on the influence of application of fertilizer and Bordeaux Mixture have been started during the current season.

(i) Influence of application of different fertilizers.

(ii) Influence of method of application of fertilizers.

(iii) Influence of frequency of applications of Bordeaux.

(iv) Influence of period and frequency of application of Bordeaux.

(v) Influence of period of application of Bordeaux.

(vi) Influence of application of various types of copper fungicidal formulations.

(vii) Influence of application of different types of Bordeaux Mixture.

(viii) Influence of application of different volumes of Bordeaux Mixture.

(ix) Influence of methods of application of Bordeaux.

Observations recorded till the end of July showed that, in none of the treatments of above trials, typical disease symptoms had developed so far. Further observations are in progress.

(*c*) *Disease control through use of different chemicals :* Trials started early in January 1959 using different chemicals *viz.*, Bordeaux, Flit–406, Terrachlor–75 W.P., Folidol E–605. Agrimycin, Ceresan and Dithane M–22, to find out their influence on the incidence of the malady were continued.

In the case of Bordeaux Mixture treatment a very high disease incidence (up to 100%) was observed, whereas in the other plots including unsprayed control, disease incidence was either nil or found to a limited extent.

To confirm the above results, repeated trials are in progress during the current season. So far no disease has been observed in any of the treatments.

(*d*) *Varietal susceptibility :* The trial started during early 1959 using the Arabica varieties ' Coorgs ', ' Kents ', and ' S. 333 ' (with and without Bordeaux as sub-treatments) to find out the varietal susceptibility to the disease was continued.

Observations continued till November 1959 showed that—

(i) Disease incidence of varying degrees, the order of susceptibility being ' Coorgs ', ' S. 333 ' and ' Kents ', was observed, where Bordeaux applications are given at periodical intervals ; whereas in all the above varieties not receiving Bordeaux application no disease incidence was observed.

(ii) In the case of ' Coorgs ' and ' S. 333 ', clear cut disease symptoms were noticeable during August and September itself, whereas in ' Kents ' the symptoms started showing off only by October.

The trial is being repeated during the current season with the arabica varieties, ' Coorgs ', ' Kents ', ' S. 795 ', ' S. 333 ', ' S. 288 ' and a Robusta.

(*e*) To investigate the other possible influencing factors in the causation of this disease, the following trials have been started during the current season :—

(i) The incidence of other seedling diseases such as Collar-rot, caused by *Rhizoctonia solani* and *Myrothecium advena* and Brown eye spot disease (*Cercospora* Sp.) in relation to Kondlie disease.

(ii) Relation between Berry Blotch disease to Kondlie.

(iii) Influence of time of sowing and transplanting.

(iv) Influence of soil temperature (controlled by frequency and quantity of water applied and overhead shade).

So far no disease has been observed in any of the trials. Observations are being continued.

V. New Records

Sclerotium disease of coffee, caused by the fungus *Sclerotium coffeicola* Stahel has been recorded for the first time in India. It was first reported in Surinam in 1917. The disease is now known to occur in British Guiana, Trinidad and Tobago, Sierra Leone, French Equatorial Africa and Tanganyika. Reports from other countries indicate that the fungus has a wide host range and that a humid atmospheric condition is necessary for development of the disease.

VI. Investigations on new type of ' Die-back '

Cases of serious incidences of ' Die-back ' of tertiary branches during the dry summer months and following the first few summer showers have been observed particularly in the south-west monsoon coffee areas. The incidence of this malady has been found to be more pronounced under more exposed and in poor soil conditions. Malformations of leaf and branch growth to varying intensities have been observed on the fresh growth taking place during the period May to July. Internal discolouration or necrosis of tissues of branches, leaf petioles, fruit peduncles and in some cases roots are also being met with. A certain amount of non-opening up of flower buds and non-setting of the blossom has also been observed. With the varied symptoms manifested, the problem would appear to be a rather complex one, wherein

nutritional, physiological and/or pathological factors might be involved. How far the death of twigs, the internal necrosis of tissues, blossom failures and malformations of leaf and branch growth are interrelated is still obscure.

In order to investigate into the pathogenic nature of the problem, collection of ' Die-back ' affected twigs, as well as plant parts showing various types of malformations are being made from different plantations. From microscopic examination and isolation in artificial culture so far made, the following micro-organisms have been found associated with ' Die-back ' affected twigs : *Colletotrichum* types, *Fusarium* Sp., *Cladosporium* Sp, *Cercospora* Sp, *Stemphyllium* Sp, *Verticillium* Sp. and two bacterial cultures, *Colletotrichum* being the predominant one in majority of cases. No organisms either of a fungual or bacterial nature could so far be detected or isolated in tissues showing internal necrosis alone, without association with external death. Similarly in the various types of leaf and branch malformations also, no micro-organisms have so far been observed. Further detailed examinations and isolations in artificial culture are being continued.

Artificial inoculations with cultures of the micro-organisms found associated with the ' Die-back ' affected twigs as well as by keeping in contact diseased tissues with healthy material, carried out during May–June period on healthy plants have failed to reproduce the disease symptoms so far. Further inoculations with the different isolates of *Colletotrichum* and Bacteria are being made. Reciprocal grafting on root and shoot systems, sap inoculations and insect transmission studies are programmed to investigate the possibilities of the virus aspect.

Possibilities of control of this malady through spraying of different fungicidal formulations are also being explored.

K. V. George
Mycologist

TABLE MY-I

Spray Experiment to compare the Efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality : 'Q' Block. Coffee Research Station, Balehonnur.
Replications : Five.
Treatments : Five.

Started : May 1957.
Plot Size : 6 × 5 = 30 plants (Gross).
Middle Five Plants (Net).

Sl. No.	Treatments	Effective Percentage of Leaf Survival						
		Initial May 1957	September 1957	February 1958	September 1958	February 1959	September 1959	February 1960
A	Cobredon. 17.6 ozs. in 40 gallons water 2 sprays ...	76.15	36.31	31.25	40.17	29.75	41.40	3.50
B	Cupricol. 1 lb. in 40 gallons water 2 sprays ...	75.60	29.08	31.00	38.64	31.66	34.50	4.30
C	Dithane-M. 22. 0.4% 4 sprays ...	82.35	44.31	42.75	42.44	29.33	43.30	7.30
D	Bordeaux Mixture 2 : 2 : 40 2 sprays ...	81.15	46.83	35.25	41.37	29.49	47.90	8.90
E	Unsprayed control ...	74.70	27.43	26.25	27.46	27.08	37.40	7.70
	General Mean ...	...	36.79	33.30	38.00	29.50	40.90	6.30
	S.E.M. ...	...	3.09	2.45	1.77	2.02	2.69	0.22
	Significance	...	Yes**	Yes**	Yes**	No.	Yes*	Yes**
	Critical Difference at 5% ...	...	9.26	7.35	5.30	...	8.07	0.66
	Conclusions		DCABE	CDABE	CDABE	...	DCAEB	DECBA

TABLE MY–II

Spray experiment to compare the efficacy of an Eradicant Fungicide with Bordeaux Mixture

Locality : Crawford area, Coffee Research Station, Balehonnur.
Started : May 1959.
Layout : Latin Square.
Plot size : 4 × 4 = 16 plants (Gross)
Replications : 4. *Treatments :* 4. 2 × 2 = 4 plants (Net)

	Treatments	Effective percentage of leaf survival		
		May 1959 initial	September 1959	February 1960
A.	Unsprayed control	99.4	38.1	7.0
B.	Eradicant fungicide 03818-B 0.35% 4 sprays	99.7	44.2	7.5
C.	Eradicant fungicide 03818-B. 0.175% 4 sprays	99.6	46.2	7.9
D.	Bordeaux Mixture. 2 sprays. 2 : 2 : 40 ...	99.6	55.2	8.9
	General Mean	...	45.90	7.80
	S.E.M.	...	5.11	1.13
	Significance	...	No	No

TABLE MY–III

Spray experiment to compare the efficacy of Proprietary Fungicides with Bordeaux Mixture

Locality : Coffee Research Sub-station, Chethalli. *Started :* May 1957.
Layout : Randomized. *Plot size :* 3 × 5 = 15 Plants (Gross)
Replications : 4. *Treatments :* 9. Middle 3 plants (Net)

	Treatments	Effective percentage of leaf survival	
		September 1959	February 1960
A.	Flit–406 0.2% 2 sprays a year	66.3	49.1
B.	Flit–406 0.4% 2 sprays a year	66.9	54.7
C.	Flit–406 0.6% 2 sprays a year	68.9	42.9
D.	Flit–406 0.4% + Tenac sticker. 2 sprays a year...	65.9	50.7
E.	Bordeaux Mixture 2 : 2 : 40 2 sprays a year ...	72.3	53.5
F.	Bordeaux Mixture + Tenac sticker. 4 sprays a year.	70.9	52.3
G.	Kirti Copper 1 lb. in 40 glns. 2 spays a year ...	62.6	62.3
H.	Unsprayed control	51.1	56.8
I.	Flit–406 0.4% + Tenac sticker. 4 sprays ...	61.0	48.3
	General Mean	65.11	52.30
	S.E.M.	4.65	4.43
	Significance	No	No

TABLE MY–IV

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Coffee Research Sub-station, Chethalli. *Started* : May 1958.

Layout : Randomized. *Plot size* : 3 × 3 = 9 plants (Gross)

Replications : 5. *Treatments :* 8. Middle plant (Net)

	Treatments	Effective percentage of leaf survival	
		September 1959	February 1960
A.	Cobredon 17.6 oz. in 40 glns. (2 sprays)	79.6	45.8
B.	Cupricol 1 lb. in 40 glns. (2 sprays)	78.2	52.5
C.	Parrycop 50 1 lb. in 40 glns. (2 sprays)	84.4	42.5
D.	Dithane M–22 0.4% (2 sprays)	84.7	52.9
E.	Bordeaux Mixture 2 : 2 : 40 (2 sprays)	87.6	44.1
F.	Bordeaux Mixture 2 : 2 : 40 + Triton X–114 (2 sprays)	71.8	57.8
G.	Dithane M–22 0.4% (4 sprays)	75.3	48.7
H.	Unsprayed control	80.4	49.2
	General Mean	80.25	49.15
	S.E.M.	7.42	4.94
	Significance	No	No

TABLE MY–V

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Woodlands Estate (Coonoor) *Started* : December 1958.

Layout : Randomized. *Plot size* : 20 × 5 = 100 plants (Gross)

Replications : 4. *Treatments* : 4. 18 × 3 = 54 plants (Net)

	Treatments	Effective percentage of leaf survival				Yield of ripe cherry in lb/acre
		Dec. 1958 Initial	Feb. 1959	Sep. 1959	Feb. 1960	1959–60
A.	Cupricol 1 lb. in 40 glns. (2 sprays) ...	79.2	71.2	63.8	46.5	1041
B.	Kirti copper 1 lb. in 40 glns. (2 sprays)	73.9	66.0	67.3	44.6	747
C.	Micro-cop 1 lb. in 40 glns. (2 sprays)	82.0	62.1	66.6	49.2	654
D.	Bordeaux Mixture 2 : 2 : 40 (2 sprays)	79.8	70.3	67.0	46.0	905
	General Mean		67.4	66.1	46.6	837
	S.E.M.		2.9	4.3	5.8	235
	Significance		No	No	No	No

TABLE MY–VI

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Pillavalli Estate (Pulneys). *Started* : September 1958.

Layout : Randomized *Plot size* : 10 × 10 = 100 plants (Gross)

Replications : 4. *Treatments* : 4. 8 × 8 = 64 plants (Net)

	Treatments	Effective percentage of leaf survival				Yield of ripe cherry in lb./acre
		Sep. 1958 Initial	Feb. 1959	Sep. 1959	Feb. 1960	1959–60
A.	Cuprokylt 1 lb. in 40 glns. water ...	79.8	72.5	Discontinued		5634
B.	Bordeaux Mixture 2 : 2 : 40 + Tenac sticker	69.9	67.4	74.1	37.2	4746
C.	Cobredon, 17.6 oz. in 40 glns. water ...	79.6	75.7	70.5	38.6	7239
D.	Bordeaux Mixture 2 : 2 : 40 ...	80.7	76.2	75.4	49.2	6051
	General Mean	...	72.95	70.0	41.66	5917
	S.E.M.	...	2.53	2.94	3.03	1134
	Significance	...	No	No	No	No

TABLE MY–VII

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Bonaventure Estate (Yercaud). *Started* : September 1958.

Layout : Randomized. *Plot size* : 20 × 5 = 100 plants (Gross)

Replications : 4. *Treatments* : 4. 18 × 3 = 54 plants (Net)

	Treatments	Effective percentage of leaf survival				Yield of ripe cherry in lb./acre
		Sep. 1958 Initial	Feb. 1959	Sep. 1959	Feb. 1960	1959–60
A.	Bordeaux Mixture 2 : 2 : 40 ...	65.1	51.3	92.4	84.7	3132
B.	Flit–406 4 lbs. in 100 glns. water ...	55.4	67.0	90.9	75.7	2058
C.	Cobredon, 17.6 oz. in 40 glns. water ...	75.3	64.7	88.2	81.9	2754
D.	Parrycop–50 1 lb. in 40 glns. water ...	67.6	59.2	92.0	76.7	2472
	General Mean	...	60.50	90.86	79.70	2604
	S.E.M.	...	4.49	1.49	2.64	568
	Significance	...	No	No	No	No

TABLE MY–VIII

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Coffee Research Sub-station, Chethalli. *Started* : September 1958.

Layout : Randomized. *Plot size* : 20 × 5 = 100 plants (Gross)

Replications : 4. *Treatments* : 4. 18 × 3 = 54 plants (Net)

	Treatments	Effective percentage of leaf survival			
		September 1958 Initial	February 1959	September 1959	February 1960
A.	Microcop 1 lb. in 40 glns. water (2 sprays).	42.5	61.0	88.5	48.5
B.	Bordeaux Mixture, 2 : 2 : 40 (2 sprays) ...	44.2	57.6	92.3	52.2
C.	Cuprokylt 1b. in 40 glns water (2 sprays)...	41.7	60.6	85.9	42.8
D.	Ultrasulphur 1 lb. in 60 glns. water (2 sprays)	39.5	67.1	82.8	40.4
	General Mean	...	61.60	87.30	45.90
	S.E.M.	...	3.19	0.86	4.31
	Significance	...	No	Yes**	No
	Critical Difference at 5%	...	...	2.77	...
	Conclusions	...	...	B A C D	...

TABLE MY–IX

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Cheekanahally Estate (Saklespur). *Started* : May 1959.

Layout : Randomized. *Plot size* : 20 × 5 = 100 plants (Gross)

Replications : 4. *Treatments* : 4. 18 × 3 = 54 plants (Net)

	Treatments	Effective percentage of leaf survival			Yield of ripe cherry in lb./acre
		May 1959 Initial	Sep. 1959	February 1960	1959–60 Basic
A.	Flit–406 0.4% (2 sprays)	52.4	72.8	60.6	606
B.	Bordeaux Mixture, 2 : 2 : 40 (2 sprays) ...	51.8	56.3	51.9	965
C.	Bordeaux Mixture 2 : 2 : 40 + Tenac sticker (2 sprays)	52.5	66.0	58.5	875
D.	Cupricol 1 lb. in 40 glns. water (2 sprays).	52.5	63.2	55.0	655
	General Mean	...	64.60	56.20	...
	S.E.M.	...	5.54	4.81	...
	Significance	...	No	No	...

TABLE MY-X

Spray experiment to compare the efficacy of proprietary fungicides with Bordeaux Mixture

Locality : Vasanthcool Estate (Chickmagalur). *Started* : May 1959.

Layout : Randomized. *Plot size* : 20 × 5 = 100 plants (Gross)

Replications : 4. *Treatments* : 4. 18 × 3 = 54 plants (Net)

	Treatments	Effective percentage of leaf survival			Yield of ripe cherry in lbs./acre
		May 1959 Initial	Sep. 1959	February 1960	1959-60 Initial
A.	Parrycop–50 1 lb. in 40 glns. (2 sprays) water	45.7	85.7	41.2	3374
B.	Bordeaux Mixture 2 : 2 : 40 (2 sprays) ...	40.2	85.2	49.0	3436
C.	Cobredon 17.6 oz. in 40 glns. (2 sprays) water	47.4	86.5	53.9	3160
D.	Kirti copper 1 lb. in 40 glns. (2 sprays) water	51.3	84.2	48.6	3334
	General Mean	...	85.40	48.20	...
	S.E.M.		1.31	4.44	
	Significance		No	No	...

TABLE MY-XI

Spray trial to find out a suitable time schedule under north-east monsoon conditions

Locality : Belvidera Estate, Shevroys.

Layout : Randomized.

Replications : 6. *Treatments :* 5.

Started : May 1957.

Plot size : 6 × 16 = 96 plants. (Gross)

4 × 14 = 56 plants. (Net)

Treatments	Effective percentage of leaf survival						Yield of ripe cherry in lb./acre		
	May 1957 initial	September 1957	February 1958	September 1958	February 1959	September 1959	1957–58 Basic	1958–59	1959–60
A. ½% Bordeaux Mixture. 3 sprays April–May, Aug-Sep. and November ...	92.0	97.5	76.5	87.3	63.2	83.7	1327	6268	4964
B. ½% Bordeaux Mixture. 2 sprays June–July and November ...	91.0	98.2	72.7	79.8	44.5	81.1	1182	7320	4734
C. ½% Bordeaux Mixture. 2 sprays. April–May and September ...	92.0	96.3	94.5	85.3	36.2	64.0	982	6965	4834
D. ½% Bordeaux Mixture. 1 spray. June–July ...	89.0	97.3	79.7	78.7	34.6	73.0	1093	6770	3964
E. Unsprayed control ...	93.0	90.7	43.8	65.1	20.0	48.9	1196	4312	3286
General Mean ...	...	96.0	73.4	79.2	39.7	70.1	...	6327	4356
S.E.M. ...	...	1.7	7.0	4.9	3.1	4.5	...	576	600
Significance ...	...	Yes*	Yes**	Yes*	Yes**	Yes**	...	Yes*	No
Critical Difference at 5% ...	...	5.1	20.7	14.5	9.2	13.3	...	1703	...
Conclusions ...		BADCE	CDABE	ACBDE	ABCDE	ABDCE	...	BCDAE	...

TABLE MY–XII

Spray experiment to find out the effects of spraying different concentrations of Bordeaux Mixture on leaf disease resistant selections

Locality : Coffee Research Sub-station, Chethalli. *Started :* June 1959.

Layout : Randomized. *Plot size :* 5 × 20 = 100 plants (Gross)

Replications : 4. *Treatments :* 5. 3 × 18 = 54 plants (Net)

Treatments	Effective percentage of leaf survival			Yield of ripe cherry in lb./acre
	June 1959 Initial	Sep. 1959	February 1960	1959–60 (Basic)
A. Bordeaux Mixture 2 : 2 : 40 (2 sprays) ...	96.8	82.5	73.5	4587
B. Bordeaux Mixture 4 : 4 : 40 (2 sprays) ...	93.7	80.7	80.8	5226
C. Bordeaux Mixture 8 : 8 : 40 (2 sprays) ...	94.3	83.4	86.6	4386
D. Flit–406 0.4% (4 sprays) ...	93.6	76.5	74.7	3848
E. Unsprayed control	99.8	77.0	68.4	5287
General Mean		80.00	76.80	...
S.E.M.		3.19	1.55	...
Significance		No	Yes**	...
Critical Difference at 5%		...	4.75	...
Conclusions		...	$\overline{C\,B\,D\,A\,E}$	

TABLE MY–XIII

Spray experiment to find out the effects of spraying the upper surface of leaves as against the normal lower surface spraying with different concentrations of Bordeaux Mixture

Locality : Crawford area, Coffee Research Station, Balehonnur.
Started : May 1959.
Layout : Randomized.
Plot size : 5 × 8 = 40 plants (Gross)
Replications : 4. *Treatments :* 5. 3 × 6 = 18 plants (Net)

Treatments	Effective percentage of leaf survival			Yield of ripe cherry in lbs. per acre
	May 1959 Initial	Sep. 1959	February 1960	1959–60 Basic
A. Unsprayed control	99.4	41.0	6.2	1717
B. Bordeaux Mixture, 2 : 2 : 40 (Normal lower surface spraying 2 sprays) ...	99.4	43.5	9.7	1330
C. Bordeaux Mixture. 2 : 2 : 40 (upper surface spraying 2 sprays)	99.8	46.0	15.2	2371
D. Bordeaux Mixture. 4 : 4 : 40 (upper surface spraying 2 sprays)	99.6	44.6	13.8	3241
E. Bordeaux Mixture. 8 : 8 : 40 (upper surface spraying 2 sprays)	99.7	48.3	12.2	1814
General Mean	...	44.70	11.40	...
S.E.M.	...	3.49	2.23	...
Significance	...	No	No	...

TABLE MY–XIV

Influence of shade on " Berry Blotch " of coffee

Treatment	Mean per-centage of the disease incidence	General mean	Standard error mean	Critical difference	Signi-ficance	Conclusion
A. Thick shade ...	4.81		...	...	...	...
B. Light shade ...	8.76	24.65	0.68	2.02	Yes*	C B A
C. Completely exposed (No shade) ...	60.40			...	...	...

TABLE MY–XV

Varietal influence on " Berry Blotch " of coffee

	Treatment	Mean percentage of the disease incidence	General mean	Standard mean	Critical difference	Significance	Conclusion
A.	S. 795 ...	16.73					
B.	S. 288 ...	7.94	15.35	1.10	3.05	Yes**	E $\overline{A}$ D C B
C.	S. 333 ...	8.35					
D.	S. 446 ...	10.39					
E.	Coorgs ...	33.34					

TABLE MY–XVI

Influence of 2 : 2 : 40 Bordeaux Mixture on " Berry Blotch " of coffee

	Treatment	Mean percentage of the disease incidence	General mean	Standard error mean	Critical difference	Significance	Conclusion
A.	Coorgs—sprayed	8.33					
B.	S. 795—sprayed	9.61	18.01	1.14	4.46	Yes**	A B $\overline{D}$ C
C.	Coorgs—unsprayed	33.34					
D.	S. 795—unsprayed	20.79					

TABLE MY–XVII

Influence of different strengths of Bordeaux Mixture and Flit–406 on " Berry Blotch " of coffee

	Treatment	Mean percentage of the disease incidence	General mean	Standard error mean	Critical difference	Significance	Conclusion
A.	2 : 2 : 40 Bordeaux Mixture ...	9.61					
B.	4 : 4 : 4 0 Bordeaux Mixture ...	4.44	10.83	0.11	0.303	Yes**	C $\overline{B}$ A $\overline{D}$ E
C.	8 : 8 : 40 Bordeaux Mixture ...	3.80					
D.	Flit–406 (0.4%)	15.50					
E.	Control (Unsprayed) ...	20.79					

VI. EXTENSION (ADVISORY) SERVICE

Salient features of work in individual Liaison Districts and divisions are summarised below :—

North Mysore Liaison Division

2. Sri B. K. Chandrappa, Senior Liaison Officer was in charge of the Liaison Division. This division comprises of the Chickmagalur, Mudigere and Saklespur Liaison Districts. An area of roughly 7,000 acres of coffee in the Alur taluk was under his direct charge for liaison activity.

3. Pest and disease position on coffee was generally at a minimum. A slight increase in the incidence of white stem borer on account of favourable seasonal conditions for the pest was noticed. The green bug was building up as a serious pest in all places where shade has been very heavily thinned out. Control measures have been suggested.

4. Intensive surveys were undertaken to gauge the occurrence and incidence of the new type of Die-back. The probable factors contributing to the malady were assessed.

5. He was on tour for 192 days, visiting 380 estates. Eighteen group gatherings of planters were addressed and 480 advisory notes were issued. Thirty-five follow-up visits were paid to loan aided estates.

Chickmagalur Liaison District

6. Sri H. S. Puttaswamy, Junior Liaison Officer was in charge of the Liaison District throughout the period under report.

7. The district has jurisdiction over the coffee areas in Chickmagalur, Tarikere and Kadur taluks. There are about 2,200 growers and the total area is approximately 32,500 acres.

8. As against a yield of 3,500 tons in 1953–54 in this liaison district, the anticipated crop for 1960–61 is 7,500 tons. The yield has thus more than doubled during the course of 6 years with only a 14% rise in the acreage.

9. The consumption of fertilizers at present is about 7,800 tons as against 2,500 tons in 1953–54. The increase is attributable to intensive advisory service.

10. The weather conditions during the period under review has been satisfactory from the point of view of crop yields. Blossom showers have been very satisfactory and were received at the right time.

11. Excepting for a noticeable incidence of white stem borer and green bug, the incidence of other pests and diseases was not significant. Leaf disease occurred in a very mild form. The incidence of the new type of ' Die-back ' has been noticed on a very mild scale.

12. Twelve demonstration plots continued to function in the district. Four plots which attained maturity were closed down and an equal number was opened in areas which needed attention. Three trial plots for demonstrating the re-oriented methods of cultivation,

four of differential manuring, three of plant protection measures, and one of Die-back demonstration were functioning in this liaison district during the year. Six Rhurstickstaff trials and one field manurial trial were discontinued. Kenyan methods of crop estimation were undertaken in two estates.

13. A total quantity of 1,107 lbs. seed coffee was distributed to 188 planters.

14. Of the three co-operative pulping units started, two continued pulping operations. Aids were offered to establish 13 individual pulping units in small planter's holdings. Thirty-one applications from planters for aids during the ensuing season were received and processed. As a result of these activities the small grower has definitely become " quality conscious ".

15. The Junior Liaison Officer toured for 236 days and visited 533 estates. Sixty-one group discussions were held. One hundred and eighty-six demonstrations were conducted. The department participated in one exhibition. One hundred and thirty-two follow-up visits were paid to loan aided estates and 10 fresh cases for aids were investigated.

Mudigere Liaison District

16. Sri K. T. Bhagath, Junior Liaison Officer was in charge of this Liaison District.

17. The year experienced good blossom showers. A 10% drop in the arabica estimates as a result of bad setting was observed in the 1959–60 crop. Leaf disease position was severe during December-January which caused defoliation and Die-back.

18. During 1960–61 the blossom showers were received in sufficient quantities and in time. Good uniform blossoming occurred in a major portion of this liaison district. On account of peculiar weather conditions in July 1960, leaf disease was noticed in a slightly severe form. Investigations were continued on Kondlie disease of young seedlings. The incidence of Die-back (new type) in a fairly severe form was reported from a few estates. Observations and field studies are under progress.

19. Critical studies on the field performance of Station selections were undertaken in 25 to 30 estates. The response of this material to blossom showers and the productive capacity were studied.

20. Eleven demonstration plots, seven reorientation plots, four differential manurial trials, one field manurial trial plot and one plant protection trial plot were in operation during the year. Kenyan method of crop estimation was undertaken in two estates.

21. A quantity of 1,519 lbs. of seed coffee was distributed to 339 planters.

22. Grafting demonstrations were conducted in one estate. Nine group gatherings of planters were addressed. The department participated in one exhibition.

23. There were 37 loan aided estates in the district to which 110 follow-up visits were paid. Thirteen applications for grants-in-aid were investigated.

24. The Liaison Officer was on tour for 160 days, visiting 294 estates. In addition to the on-the-spot suggestions offered on various problems, advisory notes were issued in over 250 cases.

Saklespur Liaison District

25. Sri K. Haridas Menon, Junior Liaison Officer was in charge of Saklespur Liaison District during the period under report.

26. The year experienced a record rainfall of 1915.9 mm. from August 1959 to July 1960. The setting of the 1959–60 crop was poor. A heavy crop of 4,160 tons is expected during the 1960–61 season.

27. Incidence of pests has almost been negligible excepting for some endemic occurrence of white stem borer and green bug in a few areas. A new kind of " Die-back " causing death of shoots mostly, in the crown portions was observed on a significant scale in many estates. Intensive surveys were conducted to assess the extent of spread and to find out the probable causative agencies. Six composite demonstration plots have been opened to find out whether the new kind of ' Die-back ' can be effectively controlled by building up plant vigour. Heavy incidence of Kondlie in a few estates were reported. First aid measures have been suggested.

28. The performance of station selections was assessed by making periodical visits and observations to selected estates. In a majority of the blocks, the station selection materials have given yields ranging from 6 to 8 cwts. per acre.

29. A total of 33 demonstration and exploratory trials were functioning at the end of the year under report. The yield levels in almost all the demonstration plots have been stepped up to 4 cwts. per acre from the pre-demonstration level of $\frac{1}{2}$ to 1 cwt. per acre.

30. The Junior Liaison Officer spent 255 days on tour and visited 309 estates. He attended 201 request calls and issued 280 advisory notes. Over 114 demonstrations on improved methods of coffee culture were conducted. Grafting demonstrations were undertaken in three estates. The Kenyan method of crop estimation was conducted in five estates.

31. Twenty-one fresh cases for loan aids were inspected for furnishing spot reports. There are 42 loan aided estates on the list. Eighty-eight follow-up visits were paid to these estates.

32. 1,168 lbs. of seed coffee were distributed to 216 planters during 1959–60 season.

33. Two co-operative pulping units continued pulping operations. A quantity of 8,070 bushels of fruit were pulped. Aids were offered to establish three individual units under Scheme V of the Development Plan.

34. The first phase of planting at the Regional Field Station was completed. The construction of one water reservoir, one well, a temporary shed, one labour line of four quarters and a pump house were completed.

35. 10,000 seedlings of S. 795 were raised at the Field Regional Station for distribution to small scale planters.

Senior Liaison Officer (Headquarters).

36. Sri W. Raghavendra Rao, Senior Liaison Officer, continued to be in charge of the post throughout the year under report.

37. He assisted the Director of Research in co-ordinating the work in several Liaison Districts in the implementation of Schemes III, V, VI of the Development Plan (collection and distribution of seed coffee, establishment of co-operative and individual pulping units, execution of the accelerated programme of organising demonstration and other trials) which came under the purview of the Research Department. Financial requirements were budgeted for and the funds properly deployed. The progress made under each of the schemes were assessed periodically to reorient methods of approach. The following account gives a summary of the work done.

(i) *Collection and distribution of seed coffee* : A total quantity of 13,148 lbs. of seed was arranged to be procured from the two stations and eight regional seed plots. Distribution of 11,986 lbs. of seed coffee to 2,512 planters was organised from 13 distribution centres. Follow-up visits to the estates supplied with seed coffee to assess the performance of the selections so issued formed an integral part of the work.

(ii) *Establishment of co-operative and individual pulping units* : Of the six co-operative pulping units started during the earlier years, five continued pulping operations. The significant feature of the working was the participation by a greater number of small scale planters.

The aids available under Scheme V of the Development Plan for establishing individual pulpers were given wide publicity. Assistance was offered to establish 17 such units during 1959–60 season bringing the total to 18 units. Eighty-two applications have been received from planters for similar aids during 1960–61 season. They are being processed.

(iii) *Demonstration plots* : Periodical visits were paid to demonstration plots to assess the progress of work against programmes given. Over 75% of these blocks have stepped up their yields to satisfactory levels of 3 to 5 cwts per acre from the pre-demonstration crop returns of $\frac{1}{2}$ to 1 cwt. per acre. These plots have encouraged many small scale planters in the neighbourhood to adopt the recommended practices in their holdings.

38. A follow-up tour to the trial plots organised by the Jhum control authorities in Assam State and the Cinchona Directorate in West Bengal State was performed by the Senior Liaison Officer along with the Botanist. Recommendations and suggestions have been offered to the concerned authorities. He visited the Agency areas of Andhra Pradesh to suggest and locate suitable areas for locating project trial centres of coffee.

39. The Senior Liaison Officer was in charge of collating and collaborating the work in the Field Regional Stations. The Field Regional Station at Pulneys came into operation in March 1960. Programme of work on the three stations at Gonicoppal, Kalpetta and Saklespur was continued. The first phase of planting in the three stations has been completed.

Construction of necessary buildings is under way. Preparations for completing the programme of planting during September 1960 were in advanced stage of progress.

40. The Senior Liaison Officer was in direct charge of the Koppa Liaison District till October 1959 when a separate complement of staff was posted to man that district. Thereafter he held supervisory charge of the Liaison activities in the zone.

41. He was on tour for 115 days and visited 183 estates. Sixteen gatherings were addressed by him. The problem of the new kind of ' Die-back ' and the causative factors for the malady engaged his attention.

Koppa Liaison District

42. Sri W. Raghavendra Rao, held direct charge of the functions in this liaison unit till October 1959. With the setting up of a separate office and establishment, the headquarters was shifted to Koppa.

43. Sri H. A. Krishna Murthy, Liaison Assistant, was placed in charge of the advisory activities.

44. The district covers an area of roughly 25,000 acres of coffee with almost equal acreages under arabica and robusta.

45. The drought period during 1960–61 was short as showers were received in January and February. Normally this zone experiences a dry season extending over 4 to 5 months. Blossom showers were received during March and April. They were ample. As against an estimate of 2,375 tons of crop for the 1959–60 season, the 1960–61 crop figures are placed at 3,980 tons.

46. Pests and diseases were significantly on low side, excepting for stray instances of green bug and shot hole borer on a moderately severe scale.

47. The station selections of arabica were seen to be comparatively free from handicapping factors like leaf disease, shanking off and die-back. S. 795 and S. 288 are having average crops of more than 5 cwts. in many estates. The station selections do not suffer to the same extent as Kents from insufficient or delayed blossom showers.

48. Sri H. A. Krishna Murthy was on tour for 197 days visiting 185 estates. Three hundred and ninety-one advisory notes were issued to planters both in person and by correspondence. Grafting demonstrations were conducted in three estates. 352 lbs. of seed coffee was distributed to 91 planters.

49. There was one loan aided block in this district. Six follow-up visits were paid to it to review the progress against programme of work given.

Yercaud Liaison District

50. The district was held in charge by Sri C. K. Vasudevan, Junior Liaison Officer.

51. The climatic conditions were favourable from the point of view of crop yields. A certain amount of difficulty was experienced for drying coffee in January-February 1960 on account of the extended North-East Monsoons. Blossom showers were received in sufficient quantities and well in time in 1960. The crop development has been very satisfactory.

52. White stem borer was seen to be prevalent in varying intensities. Timely control measures were advocated. Green bug incidence was noticed on a severe scale. Spraying with Folidol or Ekatox either individually or mixed with Bordeaux has become a general routine in the programme of operations in many estates. The incidence of leaf disease was very mild. Cercospora was noticed on young clearings on a mild scale. Berry blotch was reported from a few estates which has been controlled by spraying with Bordeaux Mixture.

53. The Junior Liaison Officer distributed 341 lbs. of seed coffee to 76 planters. He was on tour for 276 days visiting 223 estates. 249 request calls were answered. 306 advisory notes were issued. Two special problems were investigated. 25 demonstration and other trials were continued. 14 group gatherings of planters were addressed in which the departmental recommendations on the " shade problem ", " conservation of soil and moisture ", etc., were stressed. 309 follow-up visits were paid by the staff and the Junior Liaison Officer to the seven loan aided blocks situated in the district.

54. Efforts to secure a plot of land for locating the Field Regional Station were being actively pursued. The Field Regional Station is expected to commence working during the latter half of 1960.

South Mysore Liaison Division

55. Sri G. I. D'Souza, Senior Liaison Officer, was in charge of the Division throughout the period excepting for a period of 61 days from 12th December 1959 when Sri R. Vijaendraswamy was in additional current charge. He held supervisory charge of the advisory activities in Somwarpet (North Coorg), Gonicoppal (South Coorg) and Kalpetta Liaison Districts. Kalpetta Liaison District was split into two districts : Kalpetta and Manantoddy, in June 1960. An area of 5,000 acres of coffee in and around Mercara is directly looked after by the Senior Liaison Officer as personal contact zone.

56. Intensive investigations and field studies were undertaken in respect of the following problems during the year under report :

(*a*) Kondlie disease in nurseries.

(*b*) Stem cankering in arabica clearings.

(*c*) Die-back of arabica.

Observations regarding the extent of damage and probable causative agencies were made.

57. The yield in the station selection blocks kept under periodical observations ranged from 7¼ to 23 cwts. in spite of the belated receipt of blossom showers in May 1959.

58. There were 6 demonstration plots, 12 re-orientation plots and 8 plant protection, manurial and other trials in his personal contact zone. 26 demonstrations on improved

methods of coffee culture were conducted. 15 group gatherings of planters were addressed. 282 advisory notes were issued. 193 days were spent on tour contacting 313 estates.

59. Eighty-two follow-up visits were paid to 14 loan aided estates. 14 check inspections of Field Regional Stations were carried out.

North Coorg (Somwarpet) Liaison District

60. Sri P. K. Ramachandran, Junior Liaison Officer was in charge of the district till 1st July 1960. From 1st July 1960 till the end of the period under report, Sri G. I. D'Souza, Senior Liaison Officer, Mercara, was in additional charge of the zone.

61. Climatic conditions have generally been favourable for development of flush and spike following a markedly lean year for Arabica in North Coorg. Blossom showers were generally received in March-April and were followed by timely and copious backing showers. The crop position for 1960–61 is 8,000 tons over an area of 25,000 acres.

62. No loss on account of any known pests and diseases was observed during the year. Leaf disease was generally below pest level. The incidence of white stem borer was slightly higher compared to previous year, but generally below pest level. Green bug was confined to a few bushes. The incidence of the new type of Die-back reached a climax in March-April 1960 in a few estates. A type of distress, ranging from a perceptive weakening of the new wood to nipping off of the periphery and mild to acute defoliation due to an unknown factor was observed.

63. Work in 13 demonstration plots was in progress. The yield levels of these have averaged more than 4 cwts. per acre.

64. As a result of intense advisory activity, the consumption of fertilisers in this district is perhaps the highest of all the coffee growing areas of India, the quantity applied ranging from 3 to 8 cwts. per acre. Spraying against leaf disease is a mechanised operation in many estates. Pest consciousness is of an extremely high order.

65. 1,282 lbs. of seed were distributed to 359 planters during 1959–60 season.

66. The Junior Liaison Officer was on tour over 193 days visiting 305 estates. 162 advisory letters were issued in person and by correspondence and 84 request calls were attended to. 13 new applications for grants-in-aid were investigated. There are 26 loan aided blocks in this district to which 74 follow-up visits were paid.

South Coorg (Gonicoppal) Liaison District

67. Sri R. Vijaendraswamy, Junior Liaison Officer, continued to be in charge of the zone.

68. The blossom showers received in March 1960 were sufficient and an all high crop of 8,800 tons is expected. A total precipitation of 2,168.55 mm. was recorded for the period 1st August 1959 to 31st July 1960. The rainfall distribution was very even and this greatly helped the growth in new clearings.

69. Excepting for stray instances of Kondlie in a few estates no nursery diseases or pests of consequence was recorded. Mild incidence of white stem borer on arabica, shot hole borer on robusta was in evidence. Leaf diseases was mild in all estates which have adopted timely plant protection means. The incidence of the new kind of ' Die-back ' is not significant.

70. The yield of station selections in many places is more than 10 cwts. per acre.

71. There are 20 demonstration plots in this district. Seven demonstration plots which attained maturity were closed during the year and eight new ones in other estates were opened.

72. The Junior Liaison Officer was on tour for 241 days and visited 259 estates. 340 request calls were attended to. 183 demonstrations on improved methods of coffee culture were conducted. Five estates were selected and grafting methods demonstrated.

73. Nineteen applications for grants-in-aid were investigated. 108 follow-up visits were paid to 30 development loan aided estates to assess the progress achieved against programmes given.

74. 422 planters were supplied with 1,425 lbs. of seeds of station selections.

Kalpetta Liaison District

75. Sri H. Hanumantha Rao, Junior Liaison Officer, continued to be in charge of the district. He was on earned leave for a period of 45 days from 25th April 1960, when Sri M. A. Balasubramaniam was placed in charge of the post.

76. Kalpetta Liaison District was divided into two units—Kalpetta and Manantoddy on 14th June 1960. The South Wynaad (Kalpetta) Liaison Zone covers an area of 27,800 acres.

77. The rainfall for the year under report is 199.37″ which was 63.81″ above the decennial average for the period. The 1959–60 crop was 4,000 tons which is a climb-down from the previous crop of 5,500 tons to be ascribed to unfavourable weather conditions. A crop of 6,575 tonnes is forecast for 1960–61 season.

78. No major outbreaks of any pest or disease was seen during the year under report. Mild incidence of shot hole borer was in evidence in July 1960. Eelworm incidence on a mild scale was reported from one estate. Leaf disease susceptible plants in clearings of arabica station selections was up to 10%. Incidence of the Die-back complex was very mild.

79. Almost the entire area of arabica in this district is occupied by the leaf disease resistant station selections issued by the Research Department. The yields have ranged from 4 to 15 cwts. per acre.

80. 22 demonstration and other trials were in operation at the end of July 1960. 42 demonstrations on scientific cultivation practices were conducted.

81. The Junior Liaison Officer was on tour for 205 days visiting 318 estates. 37 request calls were attended to. 665 advisory notes were issued in person and by correspondence.

82. An area of 6.50 acres was planted at the Field Regional Station. A further extent of 7.00 acres has been proposed for planting during September 1960. Construction of a labour line, water reservoir and pump house was completed. Constructions of an office-cum-store and two twin field staff quarters have been taken up on hand.

Manantoddy Liaison District

83. The new liaison unit comprising of nearly 15,000 acres in the North Wynaad area was organized and established in June 1960. Sri M. A. Balasubramaniam, Junior Liaison Officer, is in charge of this district.

84. The total precipitation during 1959–60 was 107.85" as against an average of 112.65". The yield during 1959–60 is estimated at 1,000 tons and the next year's crop is placed at 2,300 tons.

85. Excepting for shot hole borer which occurred on a mild scale, no other pests and diseases to any significant extent were noticed.

86. The Junior Liaison Officer was on tour for 73 days visiting 47 estates. 13 request calls were attended to. Work in eight demonstration plots was continued. 10 group gatherings of planters were addressed. Four follow-up visits were paid to one loan aided plot. 12 applications for grants-in-aid were investigated.

Coimbatore Liaison Division

87. Sri T. V. Pattabhiraman, Senior Liaison Officer, Coimbatore held charge of this division during the entire period. The division comprised of the Pulneys, Nilgiris and South Kerala Liaison Districts each in charge of a Junior Liaison Officer. The areas of Billigiris, Anamalais, Nelliampathies, and Tirunelveli and Kanyakumari districts comprising roughly of 9,600 acres are in the personal contact zone of the Senior Liaison Officer.

88. Coffee culture in the division as a whole was considered to be very backward, the crop was small and highly variable from one year to another. However with the commencement of intense liaison activity from 1954, the fluctuations have tended to narrow down and the crop is steadily mounting up. The yields have been stepped up from 3,082 tons in 1954–55 to 10,130 tons in 1959–60.

89. One of the chief items of work attended to was to formulate a calendar of operations to suit the North-East Monsoon conditions. This has been widely publicised by the advisory services.

90. Pests and disease position during greater part of the year in 1959 was very mild. Towards the close of the year 1959, leaf disease in a severe form had appeared. Therefore, completion of the round of spray in November before the crop begins to ripen is advocated. The incidence of white stem borer is almost negligible. Black rot, Berry blotch, New Die-back, Shot hole borer were seen in a few estates on a mild scale.

91. The estimated area under station selection is about 3,000 acres and mostly S. 795 is grown. The yields from these have ranged from 7 to 8.5 cwts. per acre.

92. The Senior Liaison Officer was on tour for 211 days and visited 215 estates, and 585 planters were contacted. Seven group gatherings were addressed. A quantity of 495 lbs. of seed was issued to 28 planters.

93. Six re-orientation plots and one exploratory trial plot were in progress.

Pulneys Liaison District

94. The Liaison District continued to be in charge of Sri S. J. Mathias, Junior Liaison Officer.

95. Rainfall and climatic conditions have been optimum for coffee growth and production. A lean crop is forecast in 1960–61 after a big crop picked in 1959–60 (nearly 3,700 tons). A crop of 2,900 tons of coffee is expected for the year 1960–61 from nearly 26,000 acres.

96. Leaf disease was observed almost on a severe scale but kept under check by the institution of timely control measures, the programme being to spray every three pairs of newly formed leaves. White stem borer and green bug incidence was much below pest level. Very few instances of berryborer and leaf miner incidence were noticed.

97. 31 demonstrations and other trials were in operation. 87 request calls were attended to. 56 demonstrations on improved methods of coffee culture were undertaken. The Junior Liaison Officer was on tour for 201 days visiting 244 estates. Grafting demonstrations were conducted in two estates. A quantity of 1,528 lbs. of seed was distributed to 323 planters.

98. 27.50 acres of jungle land has been leased by the Government of Madras for starting the Field Regional Station. Sinking of a well was completed. Jungle clearing operations to plant 6.50 acres during September 1960 were undertaken.

Nilgiris (Coonoor) Liaison District

99. Sri K. C. Ananth was in charge of the district till 8th September 1959 when Sri K. R. Ahobala Rao, Junior Liaison Officer, assumed charge of the post. Sri Ahobala Rao was on leave for a period when Sri T. V. Pattabhiraman was holding additional charge.

100. The rainfall was distributed over ten months of the year, and the dry season was very short in the North-East Monsoon zone. In the South-West Monsoon area, the rainfall was above average and well distributed.

101. The weather conditions favoured a heavier incidence of leaf disease. In a majority of the neglected estates, the disease was very severe leading to severe defoliation and die-back. Green bug activity was reported in a few localities. Timely sprays have been advocated. The incidence of other known pests and diseases was very mild.

102. Arabica station selections were seen to thrive vigorously right from an elevation of 3,000′ above m.s.l. up to 5,500′. " Paddying " on account of poor and delayed monsoon showers was very negligible. Crop yields have ranged from 7 to 12 cwts. per acre.

103. 22 demonstrations and other trials were in progress. 40 demonstrations were conducted on scientific methods of cultivation. Seven group gatherings of planters were addressed. The Liaison Officer was on tour for 174 days and visited 190 estates. 360 advisory notes were issued. 90 request calls were attended to.

104. 528 lbs. of seeds of station selections were issued to 65 growers.

105. The special problems (Die-back and Kondlie) were investigated.

South Kerala (Kottayam) Liaison District

106. Sri C. K. Ponnappa, Junior Liaison Officer, continued to be in charge of the district till 7th July 1960 when he resigned and Sri P. K. Ramachandran took over and held charge of the district till the end of the period under report.

107. This is chiefly a robusta tract composed of numerous small holdings. Coffee is generally raised in small scale holdings—many in backyards as a mixed crop. Therefore the attention that is paid by the grower to this crop is very scanty. The planters are being educated regarding manuring, plant protection and other cultural operations.

108. Excepting for a severe incidence of shot hole borer, no other pest or disease was observed on pest scale.

109. The Junior Liaison Officer was on tour for 126 days visiting 221 estates. Work was in progress in 13 demonstrations and other trials. 25 group gatherings of planters were addressed. 559 lbs. of seed coffee was distributed to 221 planters.

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